PTO/AIA/15 (10-17)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	JAC023-667905
First Named Inventor	Roger P. Jackson
Title	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH S
Priority Mail Express® Label No.	Via EFS Web

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☐ **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. ☐ **Applicant asserts small entity status.** See 37 CFR 1.27
3. ☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☑ **Specification** [*Total Pages* 38] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. ☑ **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 19]
6. **Inventor's Oath or Declaration** [*Total Pages* 2] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☐ Newly executed (original or copy)
   b. ☑ A copy from a prior application (37 CFR 1.63(d))
7. ☑ **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   ☐ Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. ☐ Computer Readable Form (CRF)
   b. ☐ Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ Paper
   c. ☐ Statements verifying identity of above copies

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

ACCOMPANYING APPLICATION PAPERS

10. ☐ **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. ☑ **37 CFR 3.73(c) Statement** (*when there is an assignee*) ☑ **Power of Attorney**
12. ☐ **English Translation Document** (*if applicable*)
13. ☑ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☐ Copies of citations attached
14. ☐ **Preliminary Amendment**
15. ☐ **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. ☐ **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. ☐ **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☑ **Other:** Petition to Make Special Based on Age

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

☑ The address associated with Customer Number: 24030 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Joshua J. Pranckun/	Date	December 16, 2020
Name (Print/Type)	Joshua J. Pranckun	Registration No. (Attorney/Agent)	70712

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	JAC023-667905
	Application Number	
Title of Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Roger	P.	Jackson	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Prairie Village	State/Province	KS	Country of Residence	US

Mailing Address of Inventor:

Address 1	4706 W. 86th Street		
Address 2			
City	Prairie Village	State/Province	KS
Postal Code	66207	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	James	L.	Surber	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Kansas City	State/Province	KS	Country of Residence	US

Mailing Address of Inventor:

Address 1	1434 S. 88th Street		
Address 2			
City	Kansas City	State/Province	KS
Postal Code	66111	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	JAC023-667905
	Application Number	
Title of Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES	

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	24030		
Email Address	patentdocketing@polsinelli.com	Add Email	Remove Email

Application Information:

Title of the Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES		
Attorney Docket Number	JAC023-667905	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	19	**Suggested Figure for Publication (if any)**	2

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY MM DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	24030		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	JAC023-667905
	Application Number	
Title of Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16779304	2020-01-31

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16779304	Continuation of	15964502	2018-04-27	10548641	2020-02-04

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15964502	Continuation of	15469076	2017-03-24	9956004	2018-05-01

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15469076	Continuation of	14566356	2014-12-10	9636146	2017-05-02

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14566356	Continuation of	13694849	2013-01-10	8911479	2014-12-16

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13694849	Claims benefit of provisional	61634361	2012-02-28

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13694849	Claims benefit of provisional	61631746	2012-01-10

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

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	Application Number	
Title of Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES	

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Title of Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	JAC023-667905
	Application Number	
Title of Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

(•) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
( ) Person to whom the inventor is obligated to assign.	( ) Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix
	Roger	P.	Jackson	

Mailing Address Information For Applicant:

Address 1	4706 W. 86th Street		
Address 2			
City	Prairie Village	**State/Province**	KS
Country	US	Postal Code	66207
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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	Application Number	
Title of Invention	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix
	Roger	P.	Jackson	

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	4706 W. 86th Street		
Address 2			
City	Prairie Village	**State/Province**	KS
Country	US	Postal Code	66207
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Joshua J. Pranckun/			Date (YYYY-MM-DD)	2020-12-16
First Name	Joshua J.	Last Name	Pranckun	Registration Number	70712

Additional Signature may be generated within this form by selecting the Add button.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	MULTI-START CLOSURES FOR OPEN IMPLANTS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Roger P. Jackson Date (Optional) : _____

Signature: Roger P. Jackson

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	MULTI-START CLOSURES FOR OPEN IMPLANTS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: James L. Surber Date (Optional) : _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Roger P. Jackson

Application No./Patent No.: _____ Filed/Issue Date: _____

Titled: MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES

Roger P. Jackson, a individual

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**.

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

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6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

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☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Joshua J. Pranckun/	December 16, 2020
Signature	Date
Joshua J. Pranckun	70712
Printed or Typed Name	Title or Registration Number

ASSIGNMENT

PARTIES TO THE ASSIGNMENT:

Assignor:

James L. Surber
Kansas City, Kansas
United States of America

Assignee:

Roger P. Jackson
4706 W. 86th St.
Prairie Village, Kansas 66207
United States of America

PATENT APPLICATIONS AND PATENTS SUBJECT TO THE ASSIGNMENT:

Identified in Schedule I attached hereto.

WHEREAS, Assignor, identified above, desires to assign any and all right, title and interest to the patents and applications identified in **Schedule I** attached hereto (collectively the "Patents"), and any provisional, nonprovisional, continuation, continuation-in-part, divisional, international, foreign, regional and convention applications corresponding thereto, and any and all Letters Patent of the United States and countries and regions foreign thereto which may grant or have granted thereto or be lodged in relation thereto, any reissue or reexamination thereof or to be obtained therefor, any renewals, or substitutes thereof, and any and all priority rights or priority claims, International Convention rights, any and all rights to collect past damages for infringement of any and all Letters Patent of the United States and countries and regions foreign thereto which may be published, which may grant, or have granted thereto or be lodged in relation thereto, and other benefits accruing to or to accrue to Assignor with respect to the filing of applications for patents or securing of patents in the United States and countries foreign thereto (the "Patent Rights");

WHEREAS, Assignee, identified above, desires to acquire any and all, right, title, and interest of Assignor in and to the Patents, the Patent Rights, and in, to, and under any and all Letters Patent to be obtained therefor;

NOW THEREFORE, for the sum of $1.00 and other good and valuable consideration to Assignor in hand paid, the receipt and sufficiency of which are hereby acknowledged, Assignor has sold, assigned, and transferred and by these presents does hereby sell, assign and transfer to the said Assignee, and said Assignee's legal representatives, successors and assigns, any and all of the entire right, title and interest in and to the Patents, Patent Rights, and any and all Letters Patents to be obtained therefor;

UPON SAID CONSIDERATION, the Assignor hereby covenants and agrees with the said Assignee that he will not execute any writing or do any act whatsoever conflicting with these presents, and that he will, at any time upon request, without further or additional consideration, but at the expense of the said Assignee, execute such additional assignments

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and other writings and do such additional acts as said Assignee may deem necessary or desirable to perfect the Assignee's enjoyment of this grant, and render all necessary assistance in making application for and obtaining original, continuations, continuations-in-part, continuing prosecutions, divisionals, renewals, reissues, reexamined or extended Letters Patent of the United States, or of any and all foreign countries, on said Patent Rights, and execute confirmatory assignments or acknowledgments of this assignment as necessary for full enjoyment of the Patent Rights and for recording in foreign patent offices, and in enforcing any rights or choses in action accruing as a result of such Patent Rights, by giving testimony in any proceedings or transactions involving such Patent Rights, and by executing preliminary statements and other affidavits, it being understood that the foregoing covenant and agreement shall bind, and inure to the benefit of, the assigns and legal representatives of both parties;

UPON SAID CONSIDERATION, Assignor represents and warrants that Assignor has the right, title, and authority to execute this Assignment and to convey any and all right, title, and interest in the Patent Rights, and that Assignor has not conveyed nor will convey hereafter all or part of the Patent Rights to a third party;

ASSIGNOR HEREBY AUTHORIZES said Assignee, its successors, and assigns, or anyone it may properly designate, to apply for Letters Patent in the U.S. and any and all foreign countries and regions, in its own name if desired, and additionally to claim priority to the filing date of the Patents and Patent Applications and otherwise take advantage of the provisions of any international conventions.

IN WITNESS WHEREOF, the Assignor hereunto has executed this Assignment on the date indicated below.

Date: 2/22/2016 By: _____
James L. Surber

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ACCEPTANCE OF ASSIGNMENT

The Assignee hereby acknowledges and accepts the foregoing assignment of rights by Assignor.

IN TESTIMONY WHEREOF, the Assignee confirms its acceptance on the date set forth below.

Date: 2-22-16

Roger P. Jackson

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Schedule I

List of Assigned Patents

U.S. Issued Patents

Patent No.	Issue Date	App. No.	Filing Date	Title
8,852,239	10/07/2014	14/181,998	02/17/2014	SAGITTAL ANGLE SCREW WITH INTEGRAL SHANK AND RECEIVER
8,911,478	12/16/2014	14/086,728	11/21/2013	SPLAY CONTROL CLOSURE FOR OPEN BONE ANCHOR
8,926,672	01/06/2015	14/086,079	11/21/2013	SPLAY CONTROL CLOSURE FOR OPEN BONE ANCHOR

U.S. Patent Applications

App. No.	Filing Date	Title
62/137,707	03/24/2015	BONE ANCHOR HAVING A SNAP-FIT ASSEMBLY COUPLING AN ANCHOR HEAD TO AN ANCHOR SHANK
62/137,713	03/24/2015	BONE ANCHOR HAVING A SNAP-FIT ASSEMBLY COUPLING AN ANCHOR HEAD TO AN ANCHOR SHANK
62/194,955	07/21/2015	BONE ANCHOR ASSEMBLIES HAVING NON-PIVOTING RETAINERS AND PIVOTING SHANKS, SOME WITH PIVOTING RETAINERS
62/200,491	08/03/2015	MODULAR MULTI-FUNCTIONAL BONE ANCHOR RECEIVER ASSEMBLIES HAVING PRE-LOADED PIVOTING RETAINERS FOR CONNECTING WITH UNIVERSAL SHANK HEADS HAVING CYLINDRICAL, CONICAL, AND CURVATE CAPTURE STRUCTURES
62/200,501	08/03/2015	MODULAR MULTI-FUNCTIONAL BONE ANCHOR RECEIVER ASSEMBLIES HAVING NON-PIVOTING RETAINERS FOR CONNECTING WITH A UNIVERSAL SHANK HEAD
13/896,842	05/17/2013	POLYAXIAL BONE ANCHOR WITH POP-ON SHANK, FRICTION FIT RETAINER AND WINGED INSERT
14/061,393	10/23/2013	POLYAXIAL BONE ANCHOR WITH POP-ON MULTI-THREAD SHANK, SOME WITH DIAMETRIC INTERFERENCE FIT INSERTS
14/164,882	01/27/2014	POLYAXIAL BONE ANCHOR WITH RECEIVER WITH SPHERIC EDGE FOR FRICTION FIT
14/164,952	01/27/2014	DUAL MEDICAL IMPLANT CLOSURE DRIVE SYSTEM
14/521,030	10/22/2014	CERVICAL BONE ANCHOR WITH COLLET RETAINER AND OUTER LOCKING SLEEVE
14/566,356	12/10/2014	MULTI-START CLOSURES FOR OPEN IMPLANTS
14/567,217	12/11/2014	SPLAY CONTROL CLOSURE FOR OPEN BONE ANCHOR

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App. No.	Filing Date	Title
14/569,142	12/12/2014	BONE ANCHOR CLOSURE PIVOT-SPLAY EFFECT SHIFTING GUIDE AND ADVANCEMENT STRUCTURE WITH MODIFIED SQUARE THREAD
14/575,337	12/18/2014	SPLAY CONTROL CLOSURE FOR OPEN BONE ANCHOR
14/581,165	12/23/2014	BONE ANCHOR CLOSURE PIVOT-SPLAY CONTROL FLANGE FORM GUIDE AND ADVANCEMENT STRUCTURE
14/591,651	01/07/2015	BI-RADIAL POP-ON CERVICAL BONE ANCHOR
14/658,721	03/16/2015	POLYAXIAL BONE ANCHOR WITH POP-ON SHANK, FULLY CONSTRAINED FRICTION FIT RETAINER AND LOCK AND RELEASE INSERT
14/730,981	06/04/2015	POLYAXIAL BONE ANCHOR WITH INSERT GUIDES
14/731,064	06/04/2015	POLYAXIAL BONE ANCHOR WITH POLYMER SLEEVE
14/674,517	03/31/2015	POLYAXIAL BONE ANCHOR WITH RETAINER WITH NOTCH FOR MONO-AXIAL MOTION
14/872,621	10/01/2015	POLYAXIAL BONE ANCHOR WITH POP-ON SHANK, FRICTION FIT RETAINER WITH LOW PROFILE EDGE LOCK
14/977,430	12/21/2015	SPINAL CONNECTING MEMBERS WITH TENSIONED CORDS AND RIGID SLEEVES FOR ENGAGING COMPRESSION INSERTS

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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

■ Practitioners associated with Customer Number: 24030

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number: 24030

OR

☐	Firm or Individual Name			
	Address			
	City		State	Zip
	Country			
	Telephone		Email	

Assignee Name and Address: Roger P. Jackson
4706 W. 86th St.
Prairie Village, Kansas 66207

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	Roger P. Jackson	Date	3-6-16
Name	Roger P. Jackson	Telephone	
Title	Assignee		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of U.S. Patent Application No. 16/779,304, filed January 31, 2020, which is a continuation of U.S. Patent Application No. 15/964,502, filed April 27, 2018, now U.S. Patent No. 10, 548,641, which is a continuation of U.S. Patent Application No. 15/469,076, filed March 24, 2017, now U.S. Patent No. 9,956,004, which is a continuation of U.S. Patent Application No. 14/566,356, filed December 10, 2014, now U.S. Patent No. 9,636,146, which is a continuation of U.S. Patent Application No. 13/694,849, filed January 10, 2013, now U.S. Patent No. 8,911,479, issued December 16, 2014, which claims the benefit of U.S. Provisional Application No. 61/631,746, filed January 10, 2012 and U.S. Provisional Application No. 61/634,361, filed February 28, 2012, all of which are incorporated by reference herein for all purposes.

BACKGROUND OF THE INVENTION

[0002] The present invention is directed to structure for joining together parts of a medical implant, in particular to closure mechanisms for use with open bone anchors in spinal surgery, and in some embodiments thereof, for use with spinal bone anchors such as polyaxial screws.

[0003] Bone anchors, such as bone screws and hooks are utilized in many types of spinal surgery in order to secure various implants to vertebrae along the spinal column for the purpose of stabilizing and/or adjusting spinal alignment. For example, the most common mechanism for providing vertebral support is to implant bone screws into certain bones which then in turn support a rod or are supported by the rod. Although both closed-ended and open-ended bone anchors are known, open-ended anchors are particularly well suited for connections to longitudinal connecting members such as hard, soft or deformable rods, dynamic or elastic connectors and connector arms, because such rods or other connector members do not need to be passed through a closed bore, but rather can be laid or urged into an open channel within a receiver or head of such a bone anchor. Generally, the anchors must be inserted into the bone as an integral unit or a preassembled unit, in the form of a shank or hook and connected pivotal receiver. In some instances, a portion of such a preassembled unit, such as a shank of a polyaxial bone screw assembly, may be independently implanted into bone, followed by push- or pop-on assembly of a receiver portion of the unit.

[0004] Typical open-ended bone screws include a threaded shank with a head or receiver having a pair of parallel projecting branches or arms which form a yoke with a U-shaped slot or channel to receive a rod or other longitudinal connecting member. Hooks and other types of connectors, as are used in spinal fixation techniques, may also include similar open ends for receiving rods or portions of other fixation and stabilization structure. The open-ended head or rod receiver portion of such implants typically includes a pair of spaced arms forming a channel closed by a closure member after the rod or other longitudinal connecting member is placed in the channel. Known closures include slide-on types, twist-on varieties that are rotated ninety degrees to a locked in position, and a variety of single start helically wound guide and advancement structures including, for example, thread forms having v-thread, reverse-angle buttress or square thread forms, to name a few, as well as other non-threadlike helically wound forms. Sometimes threaded plugs are utilized with outer threaded nuts to prevent splaying of the receiver arms.

[0005] As indicated above, the force required to press a closure structure down onto a rod or other connector located between arms of an open implant is considerable. Even though a head or receiver portion of an open polyaxial bone anchor may be pivoted in a direction to make it easier for the arms of the open implant to receive a rod or other connector, spinal misalignments, irregularities and the placement of other surgical tools make it difficult to place the rod or other connector between the arms of the implant while a closure structure is mated with the open implant as well as used to push the rod or other connector downwardly into the implant. For example, when the closure is a cylindrical plug having a single start helically wound guide and advancement structure, such structure must be aligned with mating structure on one of the implant arms and then rotated until a portion of the structure is captured by mating guide and advancement structure on both arms of the implant, all the while the closure is being pressed down on the rod while other forces are pushing and pulling the rod back out of the implant. Integral or mono-axial open implants that cannot be pivoted to receive the rod are even more difficult to manipulate during the initial placement of the rod and initial mating rotation of a closure plug between the spaced, open arms of the implant. Therefore, extraordinary forces are placed on the implant and closure plug while the surgeon either pushes down on the rod or pulls up on the bone to get the rod in position between the implant arms and to initially push down upon the rod with the closure plug.

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SUMMARY OF THE INVENTION

[0006] A closure structure, top or plug of the invention for insertion between spaced arms of an open medical implant includes one or more helically wound guide and advancement features, each feature having a start surface or structure located at or near a bottom surface of the closure plug, each start structure simultaneously engaging and being captured by each of the spaced arms of the open implant upon initial rotation of the closure structure with respect to the open implant arms. According to an aspect of the invention, a double-start closure is disclosed having two helically wound forms thereon, each form having a start structure for simultaneously engaging a mating helical form on a respective open implant arm. Each time the illustrated duel- or double-start closure plug is rotated one turn (three hundred sixty degrees) between the implant arms, the closure plug advances axially into the implant and toward the rod by a width of two helical forms. The helically wound forms of the multi-start closure spiral around a cylindrical plug body thereof to an extent that the closure rotates over ninety degrees to fully or substantially receive the entire closure plug between the arms of the open implant. The illustrated closure is sized for at least one complete rotation (three hundred sixty degrees) of the plug with respect to the open implant to substantially receive the plug between the implant arms. Multi-start closures of the invention may have two or more coarse or fine helical forms, resulting in fewer or greater forms per axial distance spiraling about the closure plug body and thus resulting in plugs that rotate less (when more coarse) or more (when thin or fine) than one complete rotation to be fully received between the implant arms, typically, at least a ninety-one degree rotation is preferred.

[0007] An illustrated multi-start closure and mating open implant is in the form of non-threaded, interlocking flange forms. Also disclosed are multi-start closure structures provided with helically wound forms of other geometry, including, but not limited to helically wound threads such as reverse angle, buttress, square and v-threads. The multi-start closure may be cannulated for minimally invasive surgical applications.

[0008] Another illustrated multi-start closure embodiment of the invention is shown with a bone screw assembly having an open receiver with a pair of opposed arms, each arm having guide and advancement structure for simultaneous mating engagement with a start of the helically wound multi-start closure. A further embodiment according to the invention includes an open bone anchor receiver having integral upwardly extending break-off tabs that also have the guide and advancement structure for mating with the multi-start closure. A further embodiment

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includes an attachable/detachable guide tool cooperating with such a multi-start open receiver, the tool having inner guide and advancement structures located near a bottom thereof for rotatably and matingly receiving the multi-start closure and being synchronized with the receiver guide and advancement structure for rotating and driving the multi-start closure downward from the guide tool to the receiver.

[0009] Objects of the invention further include providing apparatus and methods that are easy to use and especially adapted for the intended use thereof and wherein the tools are comparatively inexpensive to produce. Other objects and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this invention.

[0010] The drawings constitute a part of this specification and include exemplary embodiments of the present invention and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a perspective view of an embodiment of a multi-start closure according to the invention.

[0012] FIG. 2 is another perspective view of the multi-start closure of FIG. 1.

[0013] FIG. 3 is a front elevational view of the closure of FIG. 1 shown with a portion of a receiver of a polyaxial bone screw according to FIG. 8, the receiver shown in partial front elevation with portions broken away to show the detail thereof, and further showing a rod being pressed upon by the closure, the rod also in partial front elevation with portions broken away to show the detail thereof.

[0014] FIG. 4 is a reduced top plan view of the closure of FIG. 1.

[0015] FIG. 5 is a reduced bottom plan view of the closure of FIG. 1.

[0016] FIG. 6 is an enlarged front elevational view of the closure of FIG. 1 with portions broken away to show the detail thereof.

[0017] FIG. 7 is a reduced cross-sectional view taken along the line 7-7 of FIG. 6.

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[0018] FIG. 8 a partial front elevational view of an open bone screw assembly, with portions broken away to show the detail thereof, including a receiver, a shank, a compression insert and also shown in engagement with the closure top of FIG. 1 (in reduced view) and a longitudinal connecting member in the form of a hard rod.

[0019] FIG. 9 is a front elevational view of an alternative closure of an embodiment of the invention, similar to the closure of FIG. 1, but including a break-off head, the alternative closure shown with a portion of a receiver of the polyaxial bone screw of FIG. 8 shown in enlarged and partial front elevation with portions broken away to show the detail thereof, and further showing a rod being pressed upon by the alternative closure, the rod also in partial front elevation with portions broken away to show the detail thereof.

[0020] FIG. 10 is another front elevational view of the closure of FIG. 9 with portions broken away to show the detail thereof.

[0021] FIG. 11 is a front elevational view of an alternative square-thread closure of an embodiment of the invention with portions broken away to show the detail thereof, the closure shown with a portion of a receiver of the polyaxial bone screw of FIG. 8 shown in enlarged and partial front elevation with portions broken away to show the detail thereof, and further showing a rod being pressed upon by the alternative closure, the rod also in partial front elevation with portions broken away to show the detail thereof.

[0022] FIG. 12 is a front elevational view of an alternative reverse angle closure of an embodiment of the invention with portions broken away to show the detail thereof, the closure shown with a portion of a receiver of the polyaxial bone screw of FIG. 8 shown in enlarged and partial front elevation with portions broken away to show the detail thereof, and further showing a rod being pressed upon by the alternative closure, the rod also in partial front elevation with portions broken away to show the detail thereof.

[0023] FIG. 13 is a front elevational view of an alternative v-thread closure embodiment of the invention with portions broken away to show the detail thereof, the closure shown with a portion of a receiver of the polyaxial bone screw of FIG. 8 shown in enlarged and partial front elevation with portions broken away to show the detail thereof, and further showing a rod being pressed upon by the alternative closure, the rod also in partial front elevation with portions broken away to show the detail thereof.

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[0024] FIG. 14 is a front elevational view of an alternative buttress-thread closure embodiment of the invention with portions broken away to show the detail thereof, the closure shown with a portion of a receiver of the polyaxial bone screw of FIG. 8 shown in enlarged and partial front elevation with portions broken away to show the detail thereof, and further showing a rod being pressed upon by the alternative closure, the rod also in partial front elevation with portions broken away to show the detail thereof.

[0025] FIG. 15 is a partial front elevational view of an embodiment of a multi-start open bone anchor receiver of an embodiment of the invention with portions broken away to show the detail thereof, the receiver including break-off tabs.

[0026] FIG. 16 is an enlarged and partial front elevational view of the receiver of FIG. 15 with portions broken away to show the detail thereof.

[0027] FIG. 17 is a partial front elevational view of an embodiment of a bone anchor receiver having a guide and advancement structure that matingly cooperates with the multi-start closure of FIG. 1, also shown in front elevation, the receiver having portions broken away to show the detail thereof, and further shown with a guide tool, shown in phantom, the guide tool having a multi-start guide and advancement structure receiving inner surface synchronized with the bone anchor receiver guide and advancement structure.

[0028] FIG. 18 is an exploded perspective view of the polyaxial bone screw assembly of FIG. 8.

[0029] FIG. 19 is an enlarged perspective view of the receiver of FIG. 18.

[0030] FIG. 20 is a top plan view of the receiver of FIG. 19.

[0031] FIG. 21 is a bottom plan view of the receiver of FIG. 19.

[0032] FIG. 22 is a side elevational view of the receiver of FIG. 19.

[0033] FIG. 23 is an enlarged cross-sectional view taken along the line 23-23 of FIG. 20.

[0034] FIG. 24 is an enlarged cross-sectional view taken along the line 24-24 of FIG. 22.

[0035] FIG. 25 is an enlarged cross-sectional view taken along the line 25-25 of FIG. 20.

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[0036] FIG. 26 is an enlarged perspective view of the retainer of FIG. 18.

[0037] FIG. 27 is a top plan view of the retainer of FIG. 16.

[0038] FIG. 28 is a bottom plan view of the retainer of FIG. 26.

[0039] FIG. 29 is an enlarged cross-sectional view taken along the line 29-29 of FIG. 27.

[0040] FIG. 30 is an enlarged perspective view of the compression insert of FIG. 18.

[0041] FIG. 31 is another perspective view of the insert of FIG. 30.

[0042] FIG. 32 is a top plan view of the insert of FIG. 30.

[0043] FIG. 33 is a bottom plan view of the insert of FIG. 30.

[0044] FIG. 34 is a reduced side elevational view of the insert of FIG. 30.

[0045] FIG. 35 is an enlarged cross-sectional view taken along the line 35-35 of FIG. 32.

[0046] FIG. 36 is an enlarged cross-sectional view taken along the line 36-36 of FIG. 32.

[0047] FIG. 37 is an enlarged front elevational view of the receiver and retainer of FIG. 18 with portions of the receiver broken away to show the detail thereof and shown in an early stage of assembly with the retainer.

[0048] FIG. 38 is a front elevational view with portions broken away of the receiver and retainer, similar to FIG. 37, further showing the retainer and also the compression insert of FIG. 18 in a later stage of assembly, the compression insert shown in side elevation.

[0049] FIG. 39 is a reduced front elevational view with portions broken away, similar to FIG. 38, showing the insert in a stage of being rotated into a desired position within the receiver.

[0050] FIG. 40 is a reduced front elevational view with portions broken away, similar to FIG. 39 showing the insert being rotated into the desired position.

[0051] FIG. 41 is an enlarged and partial perspective view of the assembly as shown in FIG. 40, further showing portions of the receiver pressed or crimped toward the insert to prohibit further rotation of the insert with respect to the receiver.

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[0052] FIG. 42 is an enlarged and partial, partially exploded front elevational view of the shank of FIG. 18 and also the receiver, retainer and compression insert of FIG. 18 as assembled as in FIG. 32, with portions broken away to show the detail thereof, the shank being shown implanted in a vertebra, shown in phantom, as the shank may be assembled with the receiver either before or after implantation.

[0053] FIG. 43 is a partial front elevational view, similar to FIG. 42, with portions broken away to show the detail thereof and showing the shank in a stage of assembly with the retainer.

[0054] FIG. 44 is an enlarged partial front elevational view, similar to FIG. 43, with portions broken away to show the detail thereof and showing the shank in a subsequent stage of assembly with the retainer wherein the retainer is at maximum expansion with the receiver cavity.

[0055] FIG. 45 is a reduced and partial front elevational view, similar to FIG. 44, with portions broken away to show the detail thereof wherein the shank is fully assembled with the retainer.

[0056] FIG. 46 is a partial front elevational view, similar to FIG. 45, with portions broken away to show the detail thereof and showing the retainer dropped down to a seated position within the receiver.

[0057] FIG. 47 is an enlarged and partial front elevational view with portions broken away, similar to FIG. 46 and further showing the insert after being pressed downwardly into friction fit engagement with the shank.

[0058] FIG. 48 is an enlarged and partial front elevational view with portions broken away of the assembly of Fig. 18, shown with the closure top partially assembled as also shown in FIG. 3.

[0059] FIG. 49 is an enlarged and partial front elevational view with portions broken away, similar to FIG. 48 and further showing the closure fully assembled between arms of the receiver.

[0060] FIG. 50 a reduced and partial front elevational view with portions broken away of the assembly of FIG. 49, but with the rod and closure top thereof removed and replaced with an alternative deformable rod and an alternative multi-start closure of the invention, the insert remaining locked against the receiver and thus keeping the shank locked in place during removal and replacement of the rod and closure top.

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[0061] FIG. 51 is a reduced and partial perspective view of the assembly of FIG. 49.

[0062] FIG. 52 is a partial perspective view, similar to FIG. 51, but showing the shank disposed at an eighteen degree angle (cephalic) with respect to the receiver.

[0063] FIG. 53 is a partial perspective view, similar to FIG. 52, but showing the shank disposed at an eighteen degree angle (caudal) with respect to the receiver.

[0064] FIG. 54 is a partial perspective view, similar to FIG. 53, but showing the shank disposed at an eighteen degree angle (lateral) with respect to the receiver.

[0065] FIG. 55 is a partial perspective view, similar to FIG. 54, but showing the shank disposed at a forty-two degree (medial) by eight degree (cephalic) angle with respect to the receiver.

[0066] FIG. 56 is a partial perspective view, similar to FIG. 55, but showing the shank disposed at a forty-two degree (medial) angle with respect to the receiver.

[0067] FIG. 57 is a partial perspective view, similar to FIG. 56, but showing the shank disposed at a forty-two degree (medial) by eight degree (caudal) angle with respect to the receiver.

[0068] FIG. 58 is an enlarged front elevational view of the assembly of FIG. 57 with portions broken away to show the detail thereof.

DETAILED DESCRIPTION OF THE INVENTION

[0069] As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. It is also noted that any reference to the words top, bottom, up and down, and the like, in this application refers to the alignment shown in the various drawings, as well as the normal connotations applied to such devices, and is not intended to restrict positioning of the bone attachment structures in actual use.

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[0070] Furthermore, the terms lead, pitch and start, as such terms are used to describe helically wound guide and advancement structures, are to be understood as follows: Lead is a distance along the axis of a closure plug that is covered by one complete rotation (360 degrees) of the closure plug with respect to a mating open implant. Pitch is the distance from a crest (or outer point or location) of one guide and advancement structure form to the next. For example in a single-start thread-form, such as a single start, helically wound v-thread closure plug, lead and pitch are the same. Single start means that there is only one ridge or helically wound form wrapped around a cylindrical core, or in the case of the present invention, wrapped around a cylindrical closure plug body and thus there is only one start structure or surface at a base or forward end of the closure body that initially engages a mating structure on the open implant. Each time a single start closure rotates one turn (360 degrees), the closure has advanced axially by a width of one ridge or one helical form. Double-start means that there are two ridges or forms wrapped around a core body and thus there are two starting surfaces or structures on the closure plug. Therefore, each time a double-start body rotates one turn (360 degrees), such a body has advanced axially by a width of two ridges or forms. Multi-start means that there are at least two and may be up to three or more of such ridges or forms wrapped around a core body.

[0071] With reference to FIGS. 1-8 and 18-58, and in particular to FIGS. 8 and 18, the reference number 1 generally represents an open implant in the form of a polyaxial bone screw apparatus or assembly that includes a shank 4, that further includes a body 6 integral with an upwardly extending upper portion or capture structure 8; a receiver 10; a retaining structure or retainer 12, a compression or pressure insert 14, and a multi-start closure structure or plug 18 of the invention in the form of a cylindrical plug having a double start helically wound flange-form. It is noted that multi-start closure embodiments of the invention, such as the closure 18 may be used with a variety of open implants including, but not limited to a wide variety of polyaxial screws, mono-axial or fixed screws, hooks and other types of open implants requiring a plug or closure mechanism to fix a rod or other implant member to a vertebra or other bone. Thus, the assembly 1 is only one example of how multi-start closures of the invention may be used.

[0072] The closure structure 18 presses against and captures a longitudinal connecting member, for example, a rod 21 which in turn engages the compression insert 14 that presses against the shank upper portion 8 that is attached to the retaining structure that in turn presses against an inner surface of the receiver 10, so as to capture and fix the longitudinal connecting member 21 within the receiver 10 and thus fix the member 21 relative to a vertebra (not shown).

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The illustrated receiver 10 and the shank 4 cooperate in such a manner that the receiver 10 and the shank 4 can be secured at any of a plurality of angles, articulations or rotational alignments relative to one another and within a selected range of angles both from side to side and from front to rear, to enable flexible or articulated engagement of the receiver 10 with the shank 4 until both are locked or fixed relative to each other near the end of an implantation procedure.

[0073] The illustrated rod 21 is hard, stiff, non-elastic and cylindrical, having an outer cylindrical surface 22. However, in other embodiments, the rod 21 may be elastic, deformable and/or of a different cross-sectional geometry. The rod 21 may be made from a variety of metals, metal alloys and deformable and less compressible plastics, including, but not limited to rods made of elastomeric, polyetheretherketone (PEEK) and other types of materials, such as polycarbonate urethanes (PCU) and polyethylenes. Furthermore, in lieu of a rod, longitudinal connecting members for use with the assembly 1 may take a variety of shapes, and/or may include a tensioned cord as described in greater detail herein.

[0074] It is noted that the receiver 10 includes guide and advancement structures 168 that are shown as interlocking flange forms described in greater detail in applicant's U.S. Pat. No. 6,726,689, also incorporated by reference herein. Alternately, when the closure structure includes a different helical form, the receiver cooperating structures (e.g., 168) must also be of a cooperating, mating geometry, such as a square-shaped thread receiving form, a buttress thread receiving form, a reverse angle thread receiving form or other thread-like or non-thread-like helically wound discontinuous advancement structure receiving forms for operably guiding under rotation and advancing a multi-start closure structure downward between the receiver arms 160, as well as eventual torqueing when the closure structure abuts against the rod 21 or other connecting member.

[0075] With particular reference to FIGS. 1-7, the illustrated multi-start closure structure 18 is a double start closure having a substantially cylindrical plug body 40 having an axis of rotation that is the same as that of the receiver 10 and including a helically wound guide and advancement structure in the form of a pair of helically wound forms 42 and 43, each illustrated as an interlocking flange form that operably joins with mating flange form guide and advancement structures 168 disposed on the arms of the receiver 10. The form 42 includes a start surface or structure 46 and the form 43 includes a start surface or structure 47. Each helically wound form 42 and 43 may take a variety of forms and geometries, including those described in Applicant's U.S. Pat. No. 6,726,689, which is incorporated by reference herein. It is

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noted (and also described in greater detail subsequently herein) that each of the closure structure guide and advancement structures or forms 42 and 43 could alternatively be in the form of a buttress thread, a square thread, a reverse angle thread, a v-thread or other thread like or non-thread like helically wound advancement structures, for operably guiding under rotation and advancing the closure structure downward between the arms of the receive 10 and preferably having such a nature as to resist splaying of the receiver arms when the closure structure 18 is advanced into the receiver channel. The specific flange forms 42 and 43 illustrated in FIGS. 1-7, as well as acceptable alternative locking forms, are described in detail in Applicant's U.S. Pat. No. 6,726,689, incorporated by reference herein, and thus shall not be discussed further herein. Such interlocking flange forms are preferred as the added strength provided thereby beneficially cooperate with and counter any reduction in strength caused by the any reduced profile of the receiver 10 that may more advantageously engage longitudinal connecting member components.

[0076] The illustrated closure structure 18 also includes a top surface 54 with an internal drive 56 in the form of an aperture that is illustrated as a star-shaped internal drive such as that sold under the trademark TORX, or may be, for example, a hex drive, or other internal drives such as slotted, tri-wing, spanner, two or more apertures of various shapes, and the like. A driving tool (not shown) sized and shaped for engagement with the internal drive 56 is used for both rotatable engagement and, if needed, disengagement of the closure 18 from the receiver 10 at arms 160. It is also foreseen that the closure structure 18 may alternatively include a break-off head designed to allow such a head to break from a base of the closure at a preselected torque, for example, 70 to 140 inch pounds. Such a closure structure would also include a body surface having an internal drive to be used for closure removal. A base or bottom surface 58 of the closure is planar and further includes a rim 60 for engagement and penetration into the surface 22 of the rod 21 in certain embodiments of the invention. The closure top 18 further includes a cannulation through bore 62 extending along a central axis thereof and through a drive base surface 63 and the bottom surface 58 thereof. Such a through bore provides a passage through the closure 18 interior for a length of wire (not shown) inserted therein to provide a guide for insertion of the closure top into the receiver arms 160.

[0077] The closure structure 18 helically wound flange form start structures 46 and 47 of the respective forms 42 and 43 are located on opposite sides of the closure plug body 40 and are both located adjacent the bottom surface 58. As illustrated in FIG. 3, for example, when the closure structure 18 is rotated into the receiver 10 between receiver arms 160, each having a

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guide and advancement structure 168, the start 46 engages mating guide and advancement structure 168 on one arm 160 and the start 47 simultaneously engages guide and advancement structure 168 on the opposing arm 160, both forms 42 and 43 being simultaneously captured by the mating forms 168 on the opposed arms 160. As the structure 18 is rotated, the structure advances axially downwardly between the arms 160 and presses evenly down upon the captured rod 21. Each time the illustrated duel- or double-start closure plug 18 is rotated one complete turn or pass (three hundred sixty degrees) between the implant arms, the closure plug 18 advances axially into the implant and toward the rod by a width of two helical flange forms. The illustrated closure 18 is sized for at least one complete rotation (three hundred sixty degree) of the plug 18 with respect to the receiver 10 open arms 160 to substantially receive the plug between the implant arms. Each of the start structures 46 and 47 includes a leading face having at least one curvate surface. The at least one curvate surface includes at least one radius of curvature. In one embodiment, the at least one curvate surface is both concave and convex. Multi-start closures of the invention may have two or more coarse or fine helical forms, resulting in fewer or greater forms per axial distance spiraling about the closure plug body and thus resulting in plugs that rotate less or more than one complete rotation to be fully received between the implant arms. Preferably, helically wound forms of the multi-start closure of the invention are sized so as to spiral around a cylindrical plug body thereof to an extent that the closure rotates at least ninety-one degrees to fully or substantially receive the closure plug between the arms of the bone screw receiver or other open implant. Particularly preferred guide and advancement structures are sized for at least one complete turn or pass (three-hundred sixty degree) of the closure between the receiver 10 arms and as many as two to three rotations to be fully received between implant arms.

[0078] An alternative closure top, such as the top 18' shown in FIG. 50 for use with a deformable rod, such as a PEEK rod 21', for example, includes a bottom surface 58' that has a domed portion 66' with a central nub 68' in lieu of the flat and rimmed surfaces of the closure top 18. Otherwise, the closure top 18' includes a guide and advancement structures 42' and 43', a top surface 54' and an internal drive feature 56' the same or substantially similar to the respective guide and advancement structures 42 and 43, top surface 54 and internal drive feature 56 of the closure top 18.

[0079] The shank 4, best illustrated in FIGS. 18 and 42-49, is elongate, with the shank body 6 having a helically wound bone implantable thread 124 (single or dual lead thread form) extending from near a neck 126 located adjacent to the upper portion or capture structure 8, to

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a tip 128 of the body 6 and extending radially outwardly therefrom. During use, the body 6 utilizing the thread 124 for gripping and advancement is implanted into the vertebra 17 leading with the tip 128 and driven down into the vertebra with an installation or driving tool (not shown), so as to be implanted in the vertebra to near the neck 126, as more fully described in the paragraphs below. The shank 4 has an elongate axis of rotation generally identified by the reference letter A.

[0080] The neck 126 extends axially upward from the shank body 6. The neck 126 may be of the same or is typically of a slightly reduced radius as compared to an adjacent upper end or top 132 of the body 6 where the thread 124 terminates. Further extending axially and outwardly from the neck 126 is the shank upper portion 8 that provides a connective or capture apparatus disposed at a distance from the upper end 132 and thus at a distance from the vertebra 17 when the body 6 is implanted in such vertebra.

[0081] The shank upper portion 8 is configured for a pivotable connection between the shank 4 (with attached retainer 12) and the receiver 10 prior to fixing of the shank 4 in a desired position with respect to the receiver 10. The shank upper portion 8 has an outer, convex and substantially spherical lower surface 134 that extends outwardly and upwardly from the neck 126 and terminates at a substantially planar ledge or shelf 136 that is annular and disposed perpendicular to the shank axis A. The spherical lower surface 134 has an outer radius that is the same or substantially similar to an outer radius of the retainer 12 as will be described in greater detail below, the surface 134 as well as the retainer 12 outer surface participating in the ball and socket joint formed by the shank 4 and attached retainer 12 within the partially spherical surface defining an inner cavity of the receiver 10. Extending upwardly from the ledge 136 is a cylindrical surface 138, the surface 138 having a radius that is smaller than the radius of the lower spherical surface 134. Extending outwardly from the cylindrical surface 138 is another annular surface or upper ledge 140 that faces toward the ledge 136 and is also substantially perpendicular to the axis A. As will be discussed in greater detail below, the lower ledge 136, cylindrical surface 138 and upper ledge 140 cooperate to capture and fix the resilient open retainer 12 to the shank upper portion 8, prohibiting movement of the retainer 12 along the axis A once the retainer 12 is located between the ledges 136 and 140. Extending upwardly from the upper ledge 140 is a cylindrical surface 142 having a radius smaller than the radius of the spherical surface 134 but larger than the radius of the cylindrical surface 138. Extending upwardly from the surface 142 is an upper partially spherical or domed surface 144. The spherical surface 144 has an outer radius configured for sliding cooperation and ultimate

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frictional mating with a substantially spherical concave surface of the compression insert 14 that has the same or substantially similar radius as the surface 144. The radius of the surface 144 is smaller than the radius of the lower spherical surface 134. Located near or adjacent to the surface 144 is an annular top surface 146. In the illustrated embodiment a bevel 147 extends about the spherical surface 144 and is located between the spherical surface 144 and the annular planar top surface 146.

[0082] A counter sunk substantially planar base or seating surface 149 partially defines an internal drive feature or imprint 150. The illustrated internal drive feature 150 is an aperture formed in the top surface 146 and has a multi-lobular or star-shaped aperture, such as those sold under the trademark TORX, the aperture designed to receive a tool (not shown)of an Allen wrench type, into the aperture for rotating and driving the bone screw shank 4. It is foreseen that such an internal tool engagement structure may take a variety of tool-engaging forms and may include one or more apertures of various shapes, such as a pair of spaced apart apertures or hex shape, or other geometric shape. The seat or base 149 of the drive feature 150 is disposed perpendicular to the axis A with the drive feature 150 otherwise being coaxial with the axis A. In operation, a driving tool is received in the internal drive feature 150, being seated at the base 149 and engaging the faces of the drive feature 150 for both driving and rotating the shank body 6 into the vertebra 17, either before the shank 4 is attached to the receiver 10 as shown in FIG. 42 or after the shank 4 is attached to the receiver 10, with the shank body 6 being driven into the vertebra 17 with the driving tool extending into the receiver 10.

[0083] The shank 4 shown in the drawings is cannulated, having a small central bore 151 extending an entire length of the shank 4 along the axis A. The bore 151 is defined by an inner cylindrical wall of the shank 4 and has a circular opening at the shank tip 128 and an upper opening communicating with the internal drive 150 at the surface 149. The bore 151 is coaxial with the threaded body 6 and the upper portion 8. The bore 151 provides a passage through the shank 4 interior for a length of wire (not shown) inserted into the vertebra 17 prior to the insertion of the shank body 6, the wire providing a guide for insertion of the shank body 6 into the vertebra 17.

[0084] To provide a biologically active interface with the bone, the threaded shank body 6 may be coated, perforated, made porous or otherwise treated. The treatment may include, but is not limited to a plasma spray coating or other type of coating of a metal or, for example, a calcium phosphate; or a roughening, perforation or indentation in the shank surface, such as by

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sputtering, sand blasting or acid etching, that allows for bony ingrowth or ongrowth. Certain metal coatings act as a scaffold for bone ingrowth. Bio-ceramic calcium phosphate coatings include, but are not limited to: alpha-tri-calcium phosphate and beta-tri-calcium phosphate ($Ca_3(PO_4)_2$), tetra-calcium phosphate ($Ca_4P_20_9$), amorphous calcium phosphate and hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$). Coating with hydroxyapatite, for example, is desirable as hydroxyapatite is chemically similar to bone with respect to mineral content and has been identified as being bioactive and thus not only supportive of bone ingrowth, but actively taking part in bone bonding.

[0085] With particular reference to FIGS. 18-25, the receiver 10 has a generally U-shaped appearance with a partially discontinuous substantially cylindrical inner profile and a partially cylindrical and partially faceted outer profile. The receiver 10 has an axis of rotation B that is shown in FIG. 18 as being aligned with and the same as the axis of rotation A of the shank 4, such orientation being desirable, but not required during assembly of the receiver 10 with the shank 4. After the receiver 10 is pivotally attached to the shank 4, either before or after the shank 4 is implanted in a vertebra 17, the axis B is typically disposed at an angle with respect to the axis A, as shown, for example, in FIGS. 54-58.

[0086] The receiver 10 includes a substantially cylindrical base 158 integral with a pair of opposed upstanding arms 160. A cavity, generally 161, is located within the base 158. The arms 160 form a cradle and define a U-shaped channel 162 with an upper opening, generally 163, and a U-shaped lower seat 164, the channel 162 having a width for operably snugly receiving the rod 21 between the arms 160. The channel 164 communicates with the base cavity 161. Each of the arms 160 has an interior surface, generally 166 that has a cylindrical profile and further includes a partial helically wound guide and advancement structure 168 extending radially inwardly from the surface 166 and located adjacent top surfaces 169 of each of the arms 160. In the illustrated embodiment, the guide and advancement structures 168 are each in the form of a partial helically wound interlocking flange form configured to mate under rotation with the dual start closure structure 18. Thus, unlike single start advancement structures, the helical forms 168 on the opposing arm surfaces 166 that are configured to mate with the dual start closure top 18 are reverse or flipped images of one another, the structures 168 on each arm 160 being aligned with respect to the receiver axis B, so that each closure structure start and are simultaneously engaged and captured at each arm 160 at the same time.

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[0087] The arms 160 further include an opposed pair of vertically extending outer grooves, generally 174, running substantially parallel to the receiver axis B that are centrally formed in outer curved (illustrated as faceted, both curved and planar) surfaces 176. Each groove 174 runs centrally from the respective arm top surface 169 and terminates at a through aperture 177. Each aperture 177 extends through the respective arm surface 176 and also through the respective interior arm surface 166 and is located spaced from the receiver base 158. Each groove 174 has an upper opening partially defined by a pair of opposed surfaces 179 and a substantially planar outer wall surface 181 extending between the surfaces 179. The planar wall surface 181 terminates at the top arm surface 169 and at a lower surface 182 partially defining the aperture 177. The illustrated opposed surfaces 179 are parallel and extend below the lower surface 182, partially defining the through aperture 177. The opposed surfaces 179 are sized to receive portions of an elongate tool (not shown) for locking and unlocking the insert 14 with respect to the receiver as will be described in greater detail below. In some embodiments, the surfaces 179 may be disposed at a slight angle with respect to each other, forming a dovetail-like space for maintaining a close relationship between an elongate tool (not shown) that enters into the groove 174 at the arm top surface 169 and is slidingly received between the surfaces 179. The surfaces 179 terminate at a lower surface 183 that also partially defines the through aperture 177. The surface 183 is substantially perpendicular to the surfaces 179. Thus, the illustrated through aperture 177 located below each of the grooves 174 is substantially the same width as the groove 174 there-above, resulting in the aperture 177 having a substantially rectangular profile. The through apertures 177 are sized and shaped for receiving tooling and portions of the compression insert 14 as will be described in greater detail below.

[0088] With particular reference to FIGS. 19, 22, 24, and 41, formed in the arm surfaces 176 and located on either side of the through apertures 177 are lateral crimping apertures 186. The four crimping apertures 186 are substantially circular in profile and do not extend completely through the respective arms 160, but rather terminate at a location between the arm outer surface 176 and the interior surface 166 to provide a crimping portion or wall 187. The crimping portions or walls 187 are sized and shaped for pressing or crimping some or all of the wall material inwardly onto front and rear surfaces of the insert 14 to prohibit rotation and misalignment of the insert 14 with respect to the receiver 10 as will be described in greater detail below.

[0089] The receiver 10 is a one-piece or integral structure and is devoid of any spring tabs or collet-like structures. Preferably the insert and/or receiver are configured with structure for

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blocking rotation of the insert with respect to the receiver, such as the crimp walls 187, but allowing some up and down movement of the insert with respect to the receiver during the assembly and implant procedure. Also formed in each outer arm surface 176 near the top surface 169 is an undercut tool receiving and engaging groove 189. Some or all of the apertures and grooves described herein, including, but not limited to grooves 174, apertures 177, and grooves 189 may be used for holding the receiver 10 during assembly with the insert 14, the retainer 12 and the shank 4; during the implantation of the shank body 6 into a vertebra when the shank is pre-assembled with the receiver 10; during assembly of the bone anchor assembly 1 with the rod 21 and the closure structure 18; and during lock and release adjustment of inserts according to the invention with respect to the receiver 10, either into or out of frictional engagement with the inner surfaces of the receiver 10 as will be described in greater detail below. It is foreseen that tool receiving grooves or apertures may be configured in a variety of shapes and sizes and be disposed at other locations on the receiver arm 160 outer surfaces 176 and/or inner surfaces 166 as well as surfaces defining the base 158.

[0090] Returning to the interior arm surfaces, generally 166, of the receiver arms 160, located below the discontinuous guide and advancement structure 168 is a discontinuous cylindrical surface 190 partially defining a run-out feature for the guide and advancement structure 168. Adjacent to and above the surface 190 is a discontinuous upper annular ceiling surface 191. The upper annular surface 191 includes the surface 182 that partially defines the aperture 177 and also includes bottom surfaces of the guide and advancement structure 168. Also adjacent to and below the surface 190 is a discontinuous annular surface or step 192 that in turn is adjacent to a discontinuous frusto-conical surface 193 that extends from the surface 192 inwardly toward the receiver central axis B. Adjacent the surface 193 is another substantially cylindrical discontinuous surface 194 that may in some embodiments run frusto-conical either toward or away from the axis B, depending upon, for example, clearance requirements for the top loading of assembly components, such as the retainer and a compression insert or inserts and also modifying (enlarging or reducing) a thickness for the crimping walls 187, if desired. In the current embodiment, the surface 194 terminates at a small discontinuous ledge or lip 195 directed inwardly toward the axis B. The through apertures 177 extend through both the cylindrical surfaces 190 and the surfaces 193 and 194. A cylindrical surface 196 is adjacent to and runs downwardly from the lip 195 towards the base cavity 161. A lower portion of the cylindrical surface 196 is continuous and thus partially defines the base cavity 61. The cylindrical surface 196 has a diameter smaller than a diameter of the cylindrical

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surface 190, but larger than a diameter of the surface 194. The receiver inner arm surfaces 166 may further include other sloped, stepped or chamfered surfaces between the cylindrical surfaces 190, 194, and 196 as desired for ease in assembly of the other top loaded components.

[0091] With particular reference to FIGS. 23-25, the continuous portion of the inner cylindrical surface 96 terminates at a downwardly sloping, annular ledge surface 197 that extends from the surface 196 and runs inwardly toward the receiver axis B. The surface 197 terminates at a substantially cylindrical surface 198. The surface 198 terminates at another annular surface 199 that faces a lower portion of the receiver cavity 161. The surfaces 197, 198, and 199 form an abutment or ceiling stop for the retainer 12 as will be described in greater detail below. The ceiling surface 199 runs substantially perpendicular to the axis B. Cut or otherwise formed into the surfaces 197, 198, and 199 under one of the arms 160 is a curved c-shaped notch, creating a substantially cylindrical surface 200 having a radius greater than a radius of the surface 198, the opening partially defined by the surface 200 providing clearance within the assembly 1, allowing the retainer 12 to move above the surface 197 when the shank 4 and attached retainer 12 are pivoted at a favored angle, for example, as shown in FIG. 58 and discussed in more detail below.

[0092] As stated above, the surface 199 is substantially annular and defines an upper ceiling or stop of a retainer 12 expansion portion or chamber of the inner cavity 161 that is further defined by a substantially spherical surface 202 that is adjacent to the surface 199. The surface 202 partially defines a recess that is sized and shaped to receive the retainer 12 as it expands around the shank upper portion 8 as the shank 8 is moved upwardly toward the channel 162 during assembly. Located below and adjacent to the spherical surface 202 is another curved surface 203 extending downwardly and inwardly toward the axis B. The surface 203 is illustrated as spherical, but in some embodiments the surface may be frusto-conical. The surface 203 is a seating surface for the retainer 12, the surface 203 slidingly receiving the retainer 12 until the retainer is frictionally locked against the surface 203 when downward pressure is placed on the shank 4 by the insert 14. A cylindrical surface 204 is adjacent the spherical surface 203 and an outwardly flaring surface 205, illustrated as frusto-conical, spans between the cylindrical surface 204 and a bottom surface 206 of the receiver 10. The surface 205 communicating with the bottom surface 206 to define a lower opening, generally 207 into the receiver base inner cavity 161. The cylindrical surface 204, as well as the frusto-conical surface 203 are sized and shaped to be smaller than an upper outer radial dimension of the

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retainer 12 when the retainer 12 is fixed to the shank upper portion 8, so as to form a restriction to prevent the structure 12 and attached shank portion 8 from passing through the cavity 161 and out the lower exterior 206 of the receiver 10 during operation thereof.

[0093] In various embodiments of the invention, a cut-out or aperture made of one or more notches or curved, cupped or stepped surfaces may be cut into or otherwise formed in a portion of the base surface 206, as well as in portions of the surfaces 202, 203, 204, and 205, the cupped or stepped surfaces being typically located substantially centrally and directly below one of the arm 160. Such a cupped or stepped surface or surfaces may be sized and shaped for providing clearance for an increased angle of articulation between the shank 4 and the receiver 10 in a particular or desired direction. In the present embodiment, one such arrangement of stepped surfaces, generally 208 is illustrated. In particular, the cut-out portion 208 includes a plurality of graduated, partially annular surfaces 209 connecting with a plurality of graduated partially planar and partially curved surfaces 210, the surfaces 209 and 210 defining edges for gripping the shank 4 as shown, for example in FIG. 58. The cut-out 208 is located directly below the cut-out portion 200 that provides clearance for the retainer 12 during such a favored angle pivoting of the shank 4 and attached retainer 12.

[0094] With particular reference to FIGS. 18 and 26-29, the open retainer 12 that operates to capture the shank upper portion 8 within the receiver 10 has a central axis C that is operationally the same as the axis A associated with the shank 4 when the shank upper portion 8 and the retainer 12 are installed within the receiver 10. The retainer 12 is made from a resilient material, such as a stainless steel or titanium alloy, so that the retainer 12 may be expanded during assembly as will be described in greater detail below. However, because there is little or no need to compress the retainer 12 during assembly, the opening or slit that allows for expansion of the retainer 12 is designed to be very narrow, advantageously providing substantial or almost full surface contact between the retainer and the shank upper portion 8 and also between the retainer and the receiver seating surface 203.

[0095] The retainer 12 has a central channel or hollow through bore, generally 221, that passes entirely through the structure 12 from a top surface 222 to a bottom surface 224 thereof. The bore 221 is primarily defined by a discontinuous inner cylindrical surface 225 that runs from the top surface 222 to the bottom surface 224. In some embodiments of the invention, notches or grooves may be formed in the inner and/or bottom surfaces to more evenly distribute stress across the entire retainer during expansion thereof. The retainer 12 further includes an outer

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substantially spherical surface 227 running between the top surface 222 and the bottom surface 224, the surface 227 has an identical or substantially similar radius as the receiver seating surface 203 and also the shank lower spherical surface 134. The resilient retainer 12 further includes first and second end surfaces, 230 and 231 disposed in spaced relation to one another when the retainer is in a neutral state. Both end surfaces 230 and 231 are disposed substantially perpendicular to the top surface 222 and the bottom surface 224. The embodiment shown in FIGS. 26-29 illustrates the surfaces 230 and 231 as substantially parallel, however, it is foreseen that it may be desirable to orient the surfaces obliquely or at a slight angle to the top and bottom surfaces.

[0096] With particular reference to FIGS. 18 and 30-36, the locking compression insert 14 is illustrated that is sized and shaped to be received by and down-loaded into the receiver 10 at the upper opening 166. The compression insert 14 has an operational central axis that is the same as the central axis B of the receiver 10. In operation, the insert advantageously frictionally engages the bone screw shank upper portion 8 as well as engaging the receiver 10 in an interference fit engagement, locking the shank 4 in a desired angular position with respect to the receiver 10 that remains in such locked position even if, for example, a rod and closure top are later removed and the rod is replaced with another rod or other longitudinal connecting member or member component, such as a sleeve of a tensioned cord connecting member. Such locked position may also be released by the surgeon if desired with insert engaging tools (not shown). In some embodiments of the invention, an alternative insert is provided that does not have the receiver interference fit feature, but is otherwise substantially similar to the insert 14. Such an insert includes outer surfaces that are slidingly received along the receiver 10 surfaces defining the arms 160 and the cavity 161. The locking insert 14 (as well as the non-locking alternative insert not shown) is preferably made from a solid resilient material, such as a stainless steel or titanium alloy, so that portions of the insert 14 may be grasped, pinched or pressed, if necessary, and un-wedged from the receiver 10 with a release tool (not shown).

[0097] The locking compression insert 14 includes a body 256.with cylindrical surfaces of a variety of diameters as well as planar surfaces and chamfers and cut-outs to provide clearance between the insert 14 and the retainer 12 during various steps of assembly as well as when the assembly 1 is in a final locked position. The body 256 is integral with a pair of upstanding arms 257. Located between the arms 257, the body 256 has an outer partial cylindrical surface 258. Each arm outer surface is substantially cylindrical in profile but is made from a variety of facets or faces as well as cut-outs to provide for clearance with other components of the assembly 1.

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Located on the body 256 below each upstanding arm 257 is a substantially cylindrical interference fit surface or band 159 that extends outwardly from and between an upper cylindrical surface 260 and a lower cylindrical surface 261. The lower surface 261 is adjacent to an annular bottom surface 264 of the insert 14. Each upper cylindrical surface 260 partially defines one of the insert arms 257. The interference fit band 159 runs substantially parallel to the bottom surface 264. A diameter of the insert 14 measured at the band surface 259 is larger than a diameter measured at surfaces 260 or 261. As best shown in FIG. 36, in the illustrated embodiment, the bottom surface 264 is disposed at an angle with respect to the lower surface 261, but may be perpendicular to the lower surface 261 in other embodiments. The insert 14 further includes substantially planar arm top surfaces 265 located opposite the bottom surface 264. The arms 257 are each further defined by substantially planar front and rear surfaces 266 that run from the top surfaces 265 to the bottom surface 264. At the bottom surface 264, the front and rear surfaces 266 are narrow due to clearance cut-outs 267 located at each corner of the insert 14. Each arm 257 also includes an outwardly extending wing, generally 268 located centrally on and extending outwardly from an upper cylindrical surface 269 of the arm 257, the surface 269 being adjacent to the arm top surface 265. Each arm top surface 265 also extends along the respective wing 268 to a substantially cylindrical outer surface 270. Each wing is also defined by a lower surface 271 and opposed planar side surfaces 272, the upper surfaces 265 and the lower surfaces 271 being substantially parallel to one another. The juncture between the planar side surfaces 272 and the cylindrical surface 270 may include one or more chamfered, planed, or otherwise angled or curved surface to aid in rotational assembly of the insert 14 within the receiver 10. The opposed side surfaces 272 generally span between top and bottom surfaces 265 and 271 respectively, of each wing 268, the side surfaces 272 being substantially perpendicular to adjacent top and bottom surfaces 265 and 271. The cylindrical surfaces 270 are sized and shaped for sliding rotation within the receiver arm cylindrical surfaces 190 during assembly of the insert 14 with the receiver 10 as will be described in greater detail below. The illustrated wings 268 include indicator stripes 273 that provide a surgical staff with an indication of the location of the insert 14 with respect to the receiver 10 during surgery. For example, the location of the stripe 273 with respect to the receiver 10 indicates whether the insert 14 is in a non-floppy, but movable, frictional engagement with the shank head 8 or whether the insert 14 is fully locked down on the shank head 8. The indicator stripes 273 are conveniently located on the wing cylindrical surface 270 that is visible when the wings 268 are extending through the receiver apertures 177.

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[0098] Returning to the inner surfaces of the insert 14, a through bore, generally 275, is disposed primarily within and through the body 256 and communicates with a generally U-shaped through channel formed by a saddle surface 278 that is substantially defined by the upstanding arms 257. Near the top surfaces 265, the saddle surface 278 is substantially planar. The saddle 278 has a curved lower seat 279 sized and shaped to closely, snugly engage the rod 21 or other longitudinal connecting member. It is foreseen that an alternative embodiment may be configured to include planar holding surfaces that closely hold a square or rectangular bar as well as hold a cylindrical rod-shaped, cord, or sleeved tensioned cord longitudinal connecting member. A pair of opposed, inwardly facing grooves or apertures 280 are located in the saddle 278 beginning near a juncture of the substantially planar upper portion of the saddle 278 and extending toward the curved lower seat 279. The grooves 280 are sized and shaped to receive tooling for rotation, locking, unlocking and other manipulation of the insert 14.

[0099] The bore, generally 275, is substantially defined at the body 256 by an inner cylindrical surface 282 that communicates with the seat 279 and also communicates with a lower concave, radiused or otherwise curved portion 284, that in some embodiments may include shank gripping surfaces or ridges, the surface portion 284 generally having a radius for closely mating with the surface 144 of the shank upper portion 8. The portion 284 terminates at the base surface 264. It is foreseen that the lower shank engaging portion 284 may additionally or alternatively include a roughened or textured surface or surface finish, or may be scored, knurled, or the like, for enhancing frictional engagement with the shank upper portion 8. Formed in a portion of the surface 284 and in a portion of the bottom surface 264 is a notch 286 sized and shaped to receive a portion of the retainer 12 when the shank 4 and attached retainer 12 are pivoted into a favored angle position as shown, for example, in FIG. 58. The notch 286 is located directly beneath one of the arms 257 and has a geometry for receiving a portion of the top 222 and outer spherical surface 227 of the retainer 12 when the shank upper portion 8 is fully locked into place by the insert surface 284 and the shank 4 is pivoted toward the receiver cut-out 208.

[0100] The compression insert 14 through bore 275 is sized and shaped to receive a driving tool (not shown) therethrough that engages the shank drive feature 146 when the shank body 6 is driven into bone with the receiver 10 attached. Also, in some locking embodiments of the invention, the bore receives a manipulation tool (not shown) used for releasing the insert 14 from a locked position with the receiver 10, the tool pressing down on the shank head 8 and also gripping the insert 14 at the apertures 280, or with other tool engaging features. Each of the

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arms 257 and the insert body 256 may include more surface features, such as cut-outs notches, bevels, etc. to provide adequate clearance for inserting the insert 14 into the receiver and cooperating with the retainer 12 during the different assembly steps as will be described in greater detail below.

[0101] The insert body 256 cylindrical surface 258 has a diameter slightly smaller than a diameter between crests of the guide and advancement structure 168 of the receiver 10, allowing for top loading of the compression insert 14 into the receiver opening 163, with the arms 257 of the insert 14 being located between the receiver arms 160 during insertion of the insert 14 into the receiver 10 as shown, for example, in FIG. 38. Once the arms 257 of the insert 14 are generally located beneath the guide and advancement structure 168, the insert 14 is rotated into place about the receiver axis B with the wings 268 entering the receiver groove formed by the cylindrical surface 190, the adjacent upper annular surface 191 and the adjacent lower annular surface 192 until the wings 268 are located in the apertures 177 as will be described in greater detail below.

[0102] With reference to FIGS. 18 and 48-50, the illustrated elongate rod or longitudinal connecting member 21 (of which only a portion has been shown) can be any of a variety of implants utilized in reconstructive spinal surgery, but is typically a cylindrical, elongate structure having the outer substantially smooth, cylindrical surface 22 of uniform diameter. The rod 21 may be made from a variety of metals, metal alloys and deformable and less compressible plastics, including, but not limited to rods made of elastomeric, polyetheretherketone (PEEK) and other types of materials, such as polycarbonate urethanes (PCU) and polyethylenes.

[0103] Longitudinal connecting members for use with the assembly 1 may take a variety of shapes, including but not limited to rods or bars of oval, rectangular or other curved or polygonal cross-section. The shape of the insert 14 may be modified so as to closely hold the particular longitudinal connecting member used in the assembly 1. Some embodiments of the assembly 1 may also be used with a tensioned cord. Such a cord may be made from a variety of materials, including polyester or other plastic fibers, strands or threads, such as polyethylene-terephthalate. Furthermore, the longitudinal connector may be a component of a longer overall dynamic stabilization connecting member, with cylindrical or bar-shaped portions sized and shaped for being received by the compression insert 14 of the receiver having a U-shaped, rectangular- or other- shaped channel, for closely receiving the longitudinal connecting member. The longitudinal connecting member may be integral or otherwise fixed to a bendable or

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damping component that is sized and shaped to be located between adjacent pairs of bone screw assemblies 1, for example. A damping component or bumper may be attached to the longitudinal connecting member at one or both sides of the bone screw assembly 1. A rod or bar (or rod or bar component) of a longitudinal connecting member may be made of a variety of materials ranging from deformable plastics to hard metals, depending upon the desired application. Thus, bars and rods of the invention may be made of materials including, but not limited to metal and metal alloys including but not limited to stainless steel, titanium, titanium alloys and cobalt chrome; or other suitable materials, including plastic polymers such as polyetheretherketone (PEEK), ultra-high-molecular weight-polyethylene (UHMWP), polyurethanes and composites, including composites containing carbon fiber, natural or synthetic elastomers such as polyisoprene (natural rubber), and synthetic polymers, copolymers, and thermoplastic elastomers, for example, polyurethane elastomers such as polycarbonate-urethane elastomers.

[0104] Preferably, the receiver 10, the retainer 12 and the compression insert 14 are assembled at a factory setting that includes tooling for holding, alignment and manipulation of the component pieces, as well as crimping a portion of the receiver 10 toward the insert 14. In some circumstances, the shank 4 is also assembled with the receiver 10, the retainer 12 and the compression insert 14 at the factory. In other instances, it is desirable to first implant the shank 4, followed by addition of the pre-assembled receiver, retainer and compression insert at the insertion point (see, e.g., FIG. 42). In this way, the surgeon may advantageously and more easily implant and manipulate the shanks 4, distract or compress the vertebrae with the shanks and work around the shank upper portions or heads without the cooperating receivers being in the way. In other instances, it is desirable for the surgical staff to pre-assemble a shank of a desired size and/or variety (e.g., surface treatment of roughening the upper portion 8 and/or hydroxyapatite on the shank 6), with the receiver, retainer and compression insert. Allowing the surgeon to choose the appropriately sized or treated shank 4 advantageously reduces inventory requirements, thus reducing overall cost.

[0105] Pre-assembly of the receiver 10, retainer 12 and compression insert 14 is shown in FIGS. 37-41. With particular reference to FIG. 37, first the retainer 12 is inserted into the lower receiver opening 207, leading with the outer surface 227, the top surface 222 slightly angled to face upwardly and toward one arm 160 that is located above the stepped, cut-out 208. The retainer 12 is then moved upwardly and at an angle toward the annular ceiling surface 199 located opposite the cut-out surface 200 and then past the stepped cut-out 298 in such an

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angled and upward manner into the chamber 161, followed by tilting the retainer 12 such that the top surface 222 is moved into a position within the receiver cavity 161 axially aligned with the receiver axis B and spaced from the surface 199. Then the retainer 12 is allowed to drop until the retainer spherical surface 227 is seated on the receiver spherical surface 203 as shown in FIG. 38.

[0106] Also with reference to FIG. 38 and with further reference to FIGS. 39 and 40, the. compression insert 14 is then downloaded into the receiver 10 through the upper opening 163 with the bottom surface 264 initially facing the receiver arm top surfaces 169 and the insert arms 257 located between the opposed receiver arms 160. The insert 14 is then lowered toward the channel seat 164 until the insert 14 arm upper surfaces 265 are adjacent the receiver arm inner surfaces located below the guide and advancement structures 168. Thereafter, the insert 14 is rotated in a clockwise or counter-clockwise manner about the receiver axis B until the upper arm surfaces 265 are directly below the guide and advancement structure 168 of each arm as illustrated in FIG. 40 with the U-shaped channel 278 of the insert 14 aligned with the U-shaped channel 162 of the receiver 10. In some embodiments, the insert arms 257 may need to be compressed slightly during rotation to clear inner surfaces of the receiver arms 160. As the insert 14 is rotated about the axis B, the insert wings, generally 268 slidingly rotate within the circular groove formed by the receiver surfaces 190, 191, and 192.

[0107] With particular reference to FIGS. 40 and 41, at this time, the four crimping wall portions 187 are pressed inwardly towards the insert 14 and crimping wall material thus engages the insert near front and rear surfaces 266 thereof, specifically at the four surfaces or facets 267 as best shown in FIG. 41. The crimping wall material of the wall 187 pressing against the insert 14 at a total of four locations thereby prohibits the insert 14 from rotating with respect to the receiver axis B. At this time, there can be some upward and downward movement of the insert 14, but such movement is limited as the upper wall 182 defining the receiver aperture 177 (that is also the surface 191) stops further upward movement of the insert wings 268. Downward movement of the insert 14 is prohibited by the bands 259 resting on receiver ledge surface 195 adjacent the cylindrical surface 196. The retainer 12 and the insert 14 are now in a desired position for shipping as an assembly along with the separate shank 4 and also ready for assembly with the shank 4 either at the factory, by surgery staff prior to implantation, or directly upon an implanted shank 4 as will be described herein.

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[0108] As illustrated in FIG. 42, the bone screw shank 4 or an entire assembly 1 made up of the assembled shank 4, receiver 10, retainer 12 and compression insert 14, is screwed into a bone, such as the vertebra 17, by rotation of the shank 4 using a suitable driving tool (not shown) that operably drives and rotates the shank body 6 by engagement thereof at the internal drive 150. Specifically, the vertebra 17 may be pre-drilled to minimize stressing the bone and have a guide wire (not shown) inserted therein to provide a guide for the placement and angle of the shank 4 with respect to the vertebra. A further tap hole may be made using a tap with the guide wire as a guide. Then, the bone screw shank 4 or the entire assembly 1 is threaded onto the guide wire utilizing the cannulation bore 151 by first threading the wire into the opening at the bottom 128 and then out of the top opening at the drive feature 150. The shank 4 is then driven into the vertebra using the wire as a placement guide. It is foreseen that the shank and other bone screw assembly parts, the rod 21 (also having a central lumen in some embodiments) and the closure top 18 having the central bore 62 can be inserted in a percutaneous or minimally invasive surgical manner, utilizing guide wires. When the shank 4 is driven into the vertebra 17 without the remainder of the assembly 1, the shank 4 may either be driven to a desired final location or may be driven to a location slightly above or proud to provide for ease in assembly with the pre-assembled receiver, compression insert and retainer.

[0109] With further reference to FIG. 42, the pre-assembled receiver, insert and retainer are placed above the shank upper portion 8 until the shank upper portion is received within the opening 207. With particular reference to FIGS. 43-45, as the shank upper portion 8 is moved into the interior 161 of the receiver base, the shank upper portion 8 presses upwardly against the retainer 12 in the recess partially defined by the spherical surface 202. As the portion 8 continues to move upwardly toward the channel 162, the shank surface 144 forces outward movement of the retainer 12 towards the surface 202 in the receiver expansion chamber or area as the shank 4 presses the retainer 12 up against the receiver annular ledge surface or ceiling 199. The retainer 12 initially expands about the shank upper spherical surface 144 and then slides along the cylindrical surface 142, and finally snapping or popping into the recessed cylindrical surface 138, the surface 225 of the retainer 12 fully contacting and frictionally engaging the cylindrical surface 138 between the shank lower ledge 136 and the upper ledge 140. At this time, the retainer 12 is in a neutral or slightly expanded state, fully snapped onto the shank upper portion 8 with both the retainer 12 and shank upper portion 8 in pivotal relation with the receiver 10.

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[0110] With reference to FIG. 46, the shank 4 and attached retainer 12 are then moved downwardly into a desired position with the retainer seated on the surface 203. With reference to FIG. 47, the insert 14 may be pressed downwardly by a tool (not shown) entering at the receiver grooves 174, for example, and pressing down on the insert wings 268, to result in a frictional engagement between the insert inner spherical surface 284 and the shank upper domed surface 144 to an extent that the shank is pivotable with respect to the receiver, but in a non-floppy manner. The insert 14 remains in such position due to interference fit engagement between the insert outer band surfaces 259 and the receiver cylindrical surfaces 196. Alternatively, the insert 14 may be pushed into such interference fit by a rod 21 and closure top 18. Typically, tools are first used to provide the non-floppy arrangement between the insert 14 and the shank head 8, followed by performing a locking engagement utilizing the rod 21 and closure top 18 as shown in FIG. 48. In some embodiments, when the receiver 10 is pre-assembled with the shank 4, the entire assembly 1 may be implanted after the insert 14 is pressed into non-floppy frictional engagement with the shank head 8 by inserting the driving tool (not shown) into the receiver and the shank drive 150 and rotating and driving the shank 4 into a desired location of the vertebra 17.

[0111] Again, with reference to FIG. 48 and also FIG. 49, the rod 21 is eventually positioned in an open or percutaneous manner in cooperation with the at least two bone screw assemblies 1. The closure structure 18 is then inserted into and advanced between the arms 160 of each of the receivers 10. The closure structure 18 is rotated, using a tool engaged with the inner drive 56 until a selected pressure is reached at which point the rod 21 engages the U-shaped seating surface 278 of the compression insert 14, further pressing the insert spherical surface 284 against the shank spherical surface 144, pressing the shank upper portion 8 and attached retainer 12 into locked frictional engagement with the receiver 10. With specific reference to FIGS. 3, 48, and 49, as the multi-start closure structure 18 rotates and moves downwardly into the respective receiver 10, the rim 60 engages and penetrates the rod surface 22, the closure structure 18 pressing downwardly against and biasing the rod 21 into compressive engagement with the insert 14 that urges the shank upper portion 8 and attached retainer 12 into locking engagement with the receiver, the retainer 12 spherical surface 227 frictionally abutting the spherical seating surface 203 of the receiver 10. For example, about 80 to about 120 inch pounds of torque on the closure top may be applied for fixing the bone screw shank 6 with respect to the receiver 10. Also, for example, with reference to FIGS. 52-58, when the shank 4 is disposed at an angle with respect to the receiver 10, the lower spherical surface 134 of the

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shank upper portion 8 may also be in frictional engagement with a portion of the receiver spherical seating surface 203. The retainer 12 may also expand slightly upon locking, providing a full and secure frictional locking engagement with the receiver at the surface 203.

[0112] If removal of the rod 21 from any of the bone screw assemblies 1 is necessary, or if it is desired to release the rod 21 at a particular location, disassembly is accomplished by using the driving tool (not shown) that mates with the internal drive 56 on the closure structure 18 to rotate and remove such closure structure from the cooperating receiver 10. Disassembly is then accomplished in reverse order to the procedure described previously herein for assembly.

[0113] With further reference to FIG. 49 and also with reference to FIG. 50, at this time, the closure top 18 may be loosened or removed and/or the rod 21 may be adjusted and/or removed and the frictional engagement between the insert 14 and the receiver 10 at the receiver surface 196 will remain locked in place, advantageously maintaining a locked angular position of the shank 4 with respect to the receiver 10. Thus, at this time, another rod, such as the deformable rod 21' and cooperating alternative multi-start closure top 18' may be loaded onto the already locked-up assembly to result in an alternative assembly. It is noted that the closure drive 56' may advantageously be made smaller than the drive of the closure 18, such that the deformable rod 21' is not unduly pressed or deformed during assembly since the polyaxial mechanism is already locked.

[0114] With reference to FIGS. 51-58, prior to locking the insert 14 against the shank head 8, the shank 4 may be pivoted to a plurality of potentially desirable positions with respect to the receiver 10, followed by locking of the polyaxial mechanism by fully mating the multi-start closure top 18 with the receiver 10. For example, different angular or articulated positions of the shank 4 with respect to the receiver 10 are shown, some making full use of the stepped cut-out 208 and the c-shaped groove forming the surface 200 of the receiver and/or the notch 286 of the insert 14. For reference, FIG. 51 illustrates a zero degree relationship between the shank 4 and the receiver 10. In other words, the axis A of the shank is aligned with the axis B of the receiver. FIG. 52 shows the shank 4 pivoted laterally of the receiver cut-out portion 208 in an eighteen degree cephalic relationship. FIG. 53 shows the shank 4 pivoted away from the receiver cut-out portion 208 in an eighteen degree caudal relationship. FIG. 54 illustrates the shank 4 being pivoted with respect to the receiver 10 at an eighteen degree lateral relationship. FIG. 55 shows the shank 4 pivoted toward the receiver cut-out portion 208 at a forty-two degree medial by eight degree cephalic relationship. FIG. 56 shows the shank 4 pivoted toward the

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receiver cut-out portion 208 at a forty-two degree medial relationship. FIGS. 57 and 58 show the shank 4 pivoted toward the receiver cut-out portion 208 at a forty-two degree medial by eight degree caudal relationship. FIG. 58 also shows that in such a pivoted relationship between the shank 4 and the receiver 10, a portion of the retainer 12 moves past the receiver surface 200 and is received by the notch 286 in the insert 14.

[0115] With reference to FIGS. 9 and 10, an alternative closure top 18' is shown that is almost identical to the closure top 18. However, the top 18' differs from the top 18 in that the top 18' includes a break-off head 70' that further includes a top surface 72' having tooling notches 73', an outer faceted driving surface 74', illustrated as having a hex-shaped profile, and an inner bore 76'. Otherwise, the closure top 18' includes a body 40', a first helical form 42', a second helical form 43', a body top surface 54', a body internal drive 56', a base 58', a rim 60', a cannulation bore 62' and a drive base surface 63' that is the same or substantially similar to the respective body 40, first helical form 42, second helical form 43, body top surface 54, internal drive 56, base 58, rim 60, cannulation bore 62 and drive base surface 63 previously described herein with respect to the closure top 18. The break-off head 70' is integral with the body 40' at the body top surface 54'. The inner bore 76' communicates with the inner drive 56' and the cannulation bore 62'. The break-off head 70' is designed to allow such head 70' to break from the body 40' at or near the top surface 54' at a preselected torque, for example, 70 to 140 inch pounds, when a hex-shaped tool (not shown) engages the outer surfaces 74' and drives the closure structure 18' into the receiver 10 as shown in FIG. 9. The inner drive 56' is used for disassembly or loosening of the closure 18' from the receiver 10, and re-tightening, if needed.

[0116] With reference to FIG. 11, another alternative multi-start closure top 318 is shown that is almost identical to the closure top 18 with the exception that the two flange forms 42 and 43 with respective starts 46 and 47 have been replaced with square threads 342 and 343 with respective starts 346 (not shown) and 347. Otherwise, the dual or double start closure top 318 includes a body 340, a body top surface 354, a body internal drive 356, a base 358, a rim 360', a cannulation bore 362 and a drive base surface 363 that is the same or substantially similar to the respective body 40, body top surface 54, internal drive 56, base 58, rim 60, cannulation bore 62 and drive base surface 63 previously described herein with respect to the closure top 18. In FIG. 11, the closure top 318 is shown partially wound into a polyaxial bone screw receiver 310 having opposed arms 360 with inner surfaces equipped with guide and advancement structures 368 that are sized and shaped to simultaneously closely receive and mate with the square

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threads 342 and 343 of the double closure structure 318. Otherwise, the receiver 310 is identical or substantially similar to the receiver 10.

[0117] With reference to FIG. 12, an alternative multi-start closure top 418 is shown that is almost identical to the closure top 18 with the exception that the two flange forms 42 and 43 with respective starts 46 and 47 have been replaced with reverse angle threads 442 and 443 with respective starts 446 (not shown) and 447. Otherwise, the dual or double start closure top 418 includes a body 440, a body top surface 454, a body internal drive 456, a base 458, a rim 460', a cannulation bore 462 and a drive base surface 463 that is the same or substantially similar to the respective body 40, body top surface 54, internal drive 56, base 58, rim 60, cannulation bore 62 and drive base surface 63 previously described herein with respect to the closure top 18. The closure top 418 is shown partially wound into a polyaxial bone screw receiver 410 having opposed arms 460 with inner surfaces equipped with guide and advancement structures 468 that are sized and shaped to simultaneously closely receive and mate with the reverse angle threads 442 and 443 of the double start closure structure 418. Otherwise, the receiver 410 is identical or substantially similar to the receiver 10.

[0118] With reference to FIG. 13, another alternative multi-start closure top 518 is shown that is almost identical to the closure top 18 with the exception that the two flange forms 42 and 43 with respective starts 46 and 47 have been replaced with v-threads 542 and 543 with respective starts 546 (not shown) and 547. Otherwise, the dual or double start closure top 518 includes a body 540, a body top surface 554, a body internal drive 556, a base 558, a rim 560', a cannulation bore 562 and a drive base surface 563 that is the same or substantially similar to the respective body 40, body top surface 54, internal drive 56, base 58, rim 60, cannulation bore 62 and drive base surface 63 previously described herein with respect to the closure top 18. The closure top 518 is shown partially wound into a polyaxial bone screw receiver 510 having opposed arms 560 with inner surfaces equipped with guide and advancement structures 568 that are sized and shaped to simultaneously closely receive and mate with the threads 542 and 543 of the double start closure structure 518. Otherwise, the receiver 510 is identical or substantially similar to the receiver 10.

[0119] With reference to FIG. 14, another alternative multi-start closure top 618 is shown that is almost identical to the closure top 18 with the exception that the two flange forms 42 and 43 with respective starts 46 and 47 have been replaced with buttress threads 642 and 643 with respective starts 446 and 447 (not shown). Otherwise, the dual or double start closure top 618

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includes a body 640, a body top surface 654, a body internal drive 656, a base 658, a rim 660', a cannulation bore 662 and a drive base surface 663 that is the same or substantially similar to the respective body 40, body top surface 54, internal drive 56, base 58, rim 60, cannulation bore 62 and drive base surface 63 previously described herein with respect to the closure top 18. The closure top 618 is shown partially wound into a polyaxial bone screw receiver 610 having opposed arms 660 with inner surfaces equipped with guide and advancement structures 668 that are sized and shaped to simultaneously closely receive and mate with the buttress threads 642 and 643 of the double start closure structure 618. Otherwise, the receiver 610 is identical or substantially similar to the receiver 10.

[0120] With reference to FIGS. 15 and 16, an open receiver 710 is illustrated that is substantially similar to the receiver 10 previously described herein with the exception that the receiver 710 includes opposed arms 760, each having an integral upstanding break-off extension 761. Each receiver arm 760 and integral extension 761 has an inner helically wound guide and advancement structure 768 that is sized and shaped to mate with the flange forms 42 and 43 of the dual start closure 18 previously described herein. The break-off extensions 761 are initially integral with the respective arms 760 and are then broken off by a user after the closure 18 has been rotatingly advanced along the arm extensions 761 and into the channel located between the receiver arms 760. In the illustrated embodiment, in addition to an outer groove or notch 770 located at or near a top surface 769 of each of the arms 760 where the extensions 761 break off from the receiver arms, illustrated inner arm surfaces include a recess or cut 771, best shown in FIG. 16, that runs substantially horizontally. Each recess 771 is curved and elongate and disposed somewhat cross-wise or transverse to the respective flange form 768. For example, with reference to the arm 760 shown in FIG. 16, the recess 771 cuts into a weakened region, generally 780, where the arm 760 joins with the respective attached adjacent extension 761, the curved and elongate recess 771 beginning at a lower portion or location 781 of the flange form recess or segment and terminating at an opposed upper end location of the flange form segment, while otherwise leaving the flange form 768 intact. Stated in another way, the substantially horizontally extending recess 771 cuts into both a lead portion and a trailing portion of each of the flange form segments located near and directly above the opposed arms 760 and substantially opposite the notch 770, thus further weakening the region where the extension and the arm attach, without destroying the flange form path, so that the closure 18 is not derailed by the recess 771 or otherwise prohibited from moving downwardly into the receiver channel formed between the receiver arms 760.

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[0121] With reference to FIG. 17, the multi-start closure 18 is shown cooperating with a spinal implant receiver, such as a bone screw receiver 10' and a discrete, detachable guide tool 801. The elongate guide tool 801, only partially shown in FIG. 17, is typically sized for extending from the bone screw receiver 10' upwardly to a location outside of a patient, the tool providing a guide channel for operably guiding the rod 21 or other longitudinal connecting member from a position exterior of the bone screw receiver 10' toward and into the bone screw receiver 10'. The illustrated guide tool has opposed arms 805, each arm having a helical guide and advancement structure 810 thereon that is illustrated as a square thread form, but may be of other geometry, including a flange form the same or similar to the flange forms 168' of the receiver 10' that mates with the flange forms 42 and 43 of the closure structure 18. Thus, the illustrated structures 810 are sized and shaped for receiving and rotating engagement with a dual start closure. The closure 18 is shown partially wound into the receiver 10' that is identical or substantially similar to the receiver 10 with the exception of certain outer arm surface features (not shown). Thus, the receiver 10' includes opposed arms 160' with inner surfaces having guide and advancement structures 168' that are sized and shaped to simultaneously closely receive and mate with the flange forms 42 and 43 of the dual start closure structure 18. The guide tool 801 includes attachment structure for detachable attachment to the receiver 10'(not shown), that may take a variety of forms and methods, including, but not limited to a slide-on, slide-off attachment, a snap-on, rotate off attachment, a rotate-on and rotate-off attachment, to name a few. For example, cooperating attachment structure for both the tool and the receiver may be used that is disclosed in U.S. Pat. No. 7,470,279 and incorporated by reference herein. Returning to the inner helically wound guide and advancement structure 810 formed on each arm 804 of the guide tool 801, the structure 810 is sized and shaped for being aligned with the receiver arms 160' during removable attachment of the tool 801 with the respective bone screw receiver 10' so as to continue the helical pathway for the closure 18, the structures 810 being synchronized with the flange forms 168' to allow for the rotation and driving transfer of the closure 18 from the tool 801 into the receiver 10'.

[0122] It is to be understood that while certain forms of the present invention have been illustrated and described herein, it is not to be limited to the specific forms or arrangement of parts described and shown.

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CLAIMS

1. A medical implant assembly comprising:

a receiver having a first arm and a second arm spaced apart from each other by a channel, the first arm and the second arm each having a top surface and an inner surface, the first and second arms each having a discontinuously helically wound thread extending up to the top surface, the channel being formed by the first arm and the second arm opening onto the top surfaces and configured to receive a rod; and

a closure being threaded and configured to close the channel, the closure having an axis of rotation and a continuously helically wound thread form, the continuously helically wound thread form having a start structure and an upper loading surface extending between a root and a crest of the continuously helically wound thread form, the start structure having a leading face extending below the upper loading surface, the leading face including a partial concave surface adjacent the root and a partial convex surface adjacent the crest, the partial concave and partial convex surfaces each defined by a radius of curvature that is substantially equal with respect to each other.

2. The medical implant assembly of claim 1, wherein the partial concave surface tangentially blends with the partial convex surface.

3. The medical implant assembly of claim 1, wherein the start structure is a first start structure disposed at a diametrically opposite location on the closure from a second start structure.

4. The medical implant assembly of claim 1, wherein the continuously helically wound thread form of the closure includes a lower surface disposed between the root and the crest, and wherein the leading face of the start structure extends between the upper loading surface and the lower surface.

5. The medical implant assembly of claim 1, wherein the leading face of the start structure includes at least a partial planar surface.

6. The medical implant assembly of claim 1, wherein the first arm includes a first breakoff extension coupled to the top surface of the first arm, and the second arm includes a second breakoff extension coupled to the top surface of the second arm, each of the first and second breakoff extensions including an inner surface having a discontinuously helically wound thread

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form, the discontinuously helically wound thread form of the first breakoff extension configured to cooperate with the discontinuously helically wound thread of the first arm, and the discontinuously helically wound thread form of the second breakoff extension configured to cooperate with the discontinuously helically wound thread of the second arm to rotatably transfer the closure there between prior to the first and second breakoff extensions being separated from the first and second arms, respectively.

7. The medical implant assembly of claim 6, wherein a first outer radiused notch is located at a convergence of the first breakoff extension and the first arm at the top surface thereof, and a second outer radiused notch is located at a convergence of the second breakoff extension and the second arm at the top surface thereof, the first outer radiused notch being located opposite a first inner radiused recess, and the second outer radiused notch being located opposite a second inner radiused recess.

8. The medical implant assembly of claim 1, wherein the start structure includes a bottom beveled surface.

9. The medical implant assembly of claim 1, wherein the upper loading surface of the continuously helically wound thread form of the threaded closure slopes rearward from the root to towards the crest.

10. The medical implant assembly of claim 9, wherein the slope of the upper loading surface is greater than five degrees measured from a horizontal line drawn tangent along the upper loading surface.

11. A medical implant assembly comprising:

a receiver having a first arm and a second arm spaced apart from each other by a channel, the first arm and the second arm each having a top surface and an inner surface, the first and second arms having discontinuously helically wound threads extending up to the top surface, the channel being formed by the first arm and the second arm opening onto the top surfaces and configured to receive a rod; and

a closure configured to close the channel, the closure having an axis of rotation and a continuously helically wound thread form comprising a first thread and a second thread, the first thread comprising a first start structure and a first upper loading surface extending between a first root and a first crest of the first thread, the first start structure including a first leading face

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extending below the first upper loading surface, the second thread comprising a second start structure and a second upper loading surface extending between a second root and a second crest of the second thread, the second start structure including a second leading face extending below the second upper loading surface, the first and second leading faces each including a partial concave surface adjacent the first and second root, respectively, and a partial convex surface adjacent the first and second crest, respectively, the partial concave and partial convex surfaces of the first and second leading faces each defined by a radius that is substantially equal with respect to each other.

12. The medical implant assembly of claim 11, wherein the first start structure and the second start structure are disposed at diametrically opposite locations from each other on the closure.

13. The medical implant assembly of claim 11, wherein the first leading face includes a first inflection point between the partial concave surface and the partial convex surface of the first leading face, and the second leading face includes a second inflection point between the partial concave surface and the partial convex surface of the second leading face.

14. The medical implant assembly of claim 11, wherein the first thread includes a first lower surface disposed between the first root and the first crest and the second thread includes a second lower surface disposed between the second root and the second crest, and wherein the first leading face extends between the first upper loading surface and the first lower surface and the second leading face extends between the second upper loading surface and the second lower surface.

15. The medical implant assembly of claim 11, wherein the first and second leading faces each includes at least a partial planar surface.

16. The medical implant assembly of claim 11, wherein the top surfaces of the first and second arms each include a breakoff extension with an inner surface having a discontinuously helically wound thread form, the first and second arm breakoff extension thread forms being continuous with the respective discontinuously helically wound thread form on the inner surface of the first and second arms.

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17. The medical implant assembly of claim 11, wherein the first start structure includes a first bottom beveled surface and the second start structure includes a second bottom beveled surface.

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ABSTRACT

A medical implant assembly including a receiver and a closure. The receiver having first and second arms each having a discontinuously helically wound thread extending up to a top surface thereof. The closure being threaded and configured to close the channel. The closure having an axis of rotation and a continuously helically wound thread form. The continuously helically wound thread form having a start structure and an upper loading surface extending between a root and a crest of the continuously helically wound thread form. The start structure having a leading face extending below the upper loading surface. The leading face including a partial concave surface adjacent the root and a partial convex surface adjacent the crest. The partial concave and partial convex surfaces each defined by a radius of curvature that is substantially equal with respect to each other.

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Fig. 1.

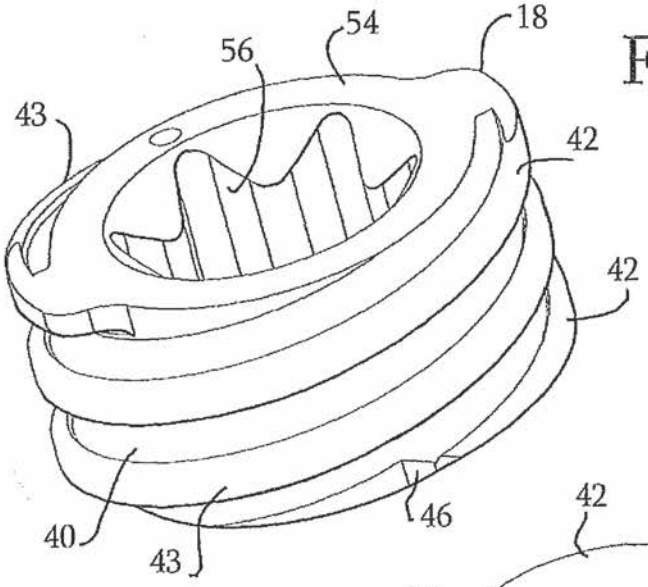


Fig. 2.

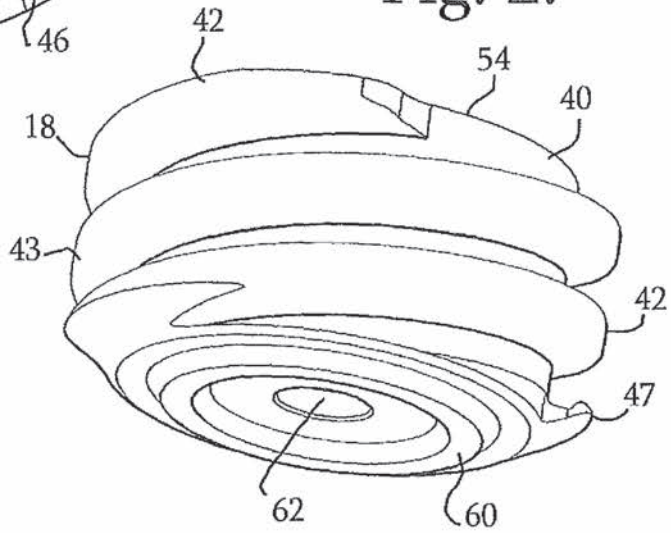
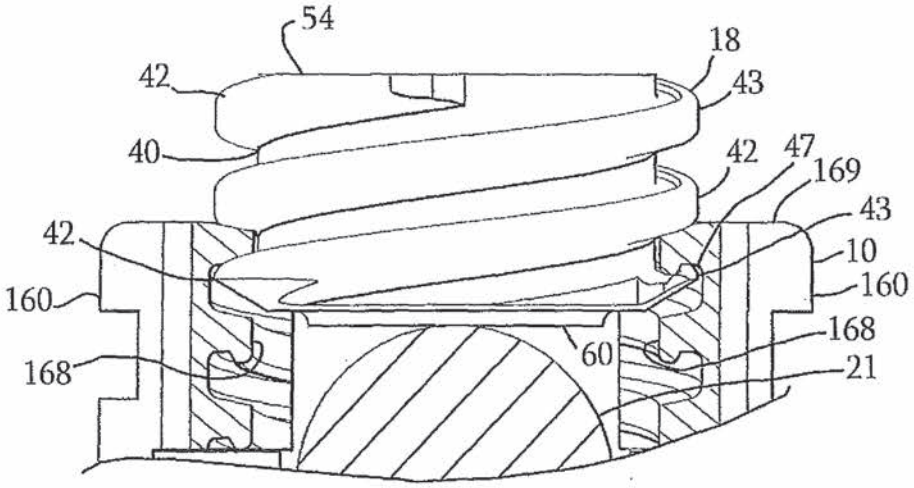


Fig. 3.



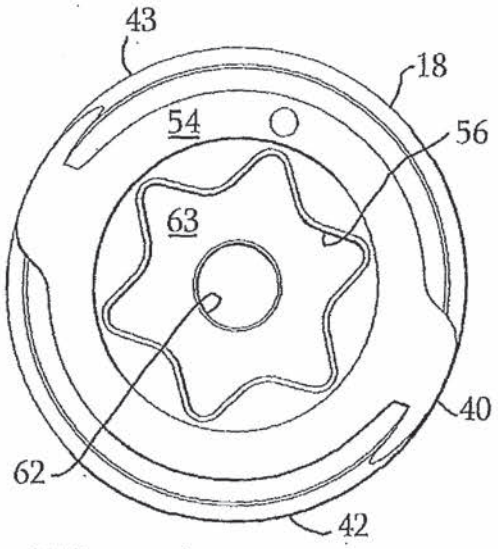


Fig. 4.

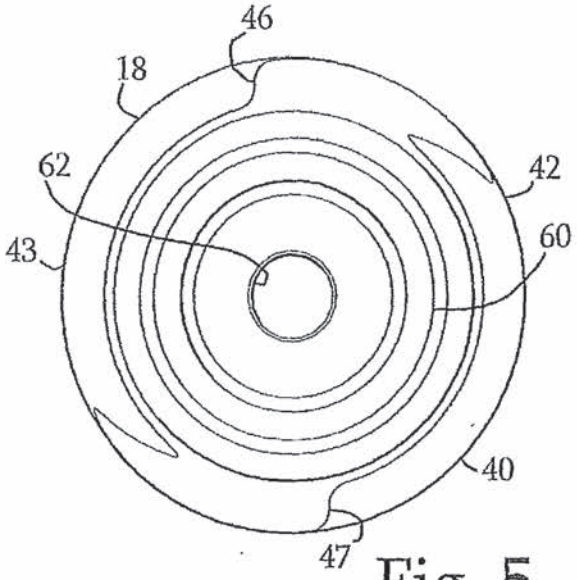


Fig. 5.

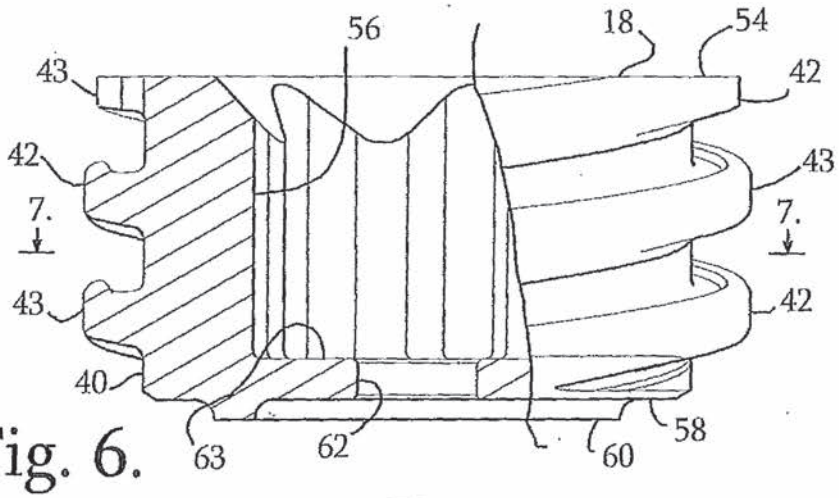


Fig. 6.

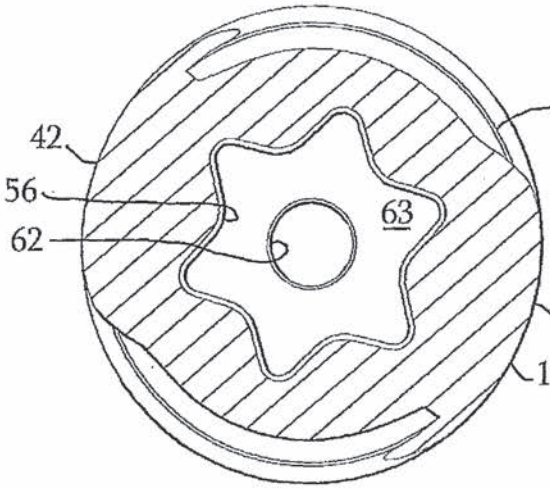


Fig. 7.

Fig. 8.

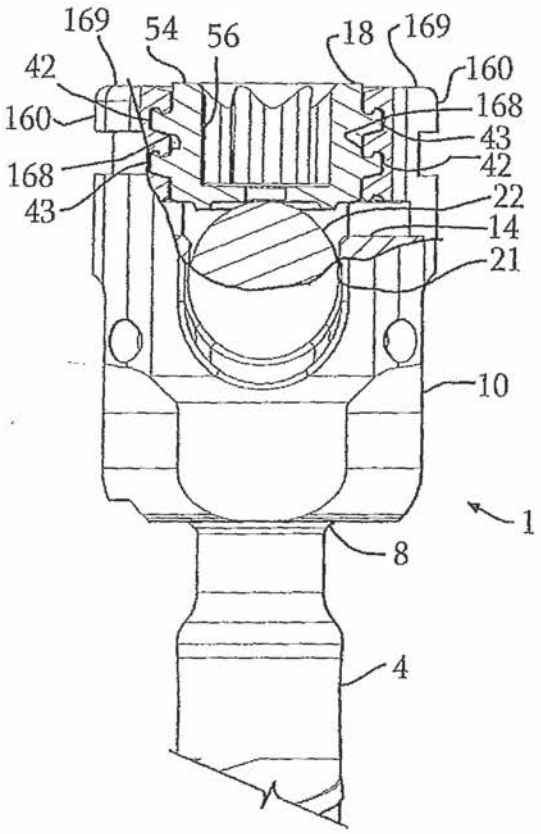


Fig. 9.

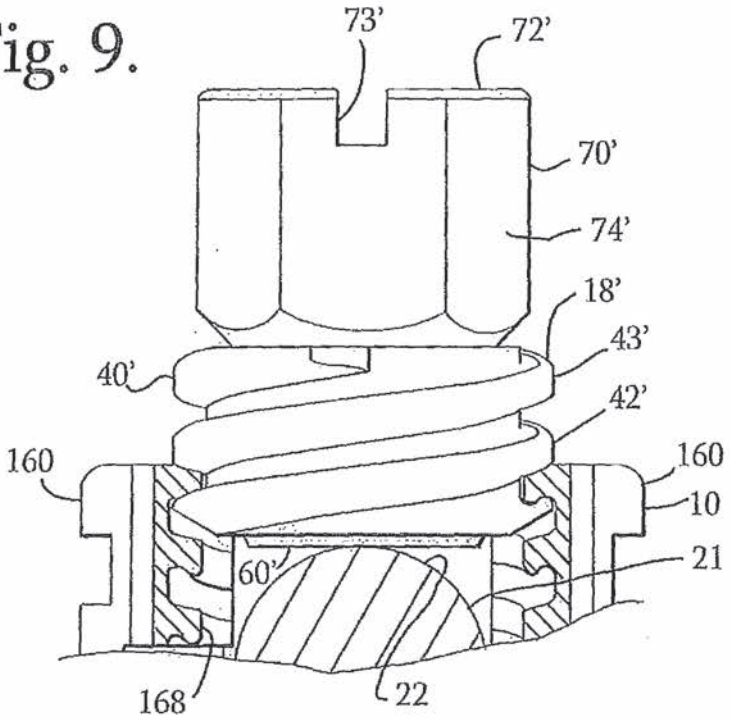

73'
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Fig. 10.

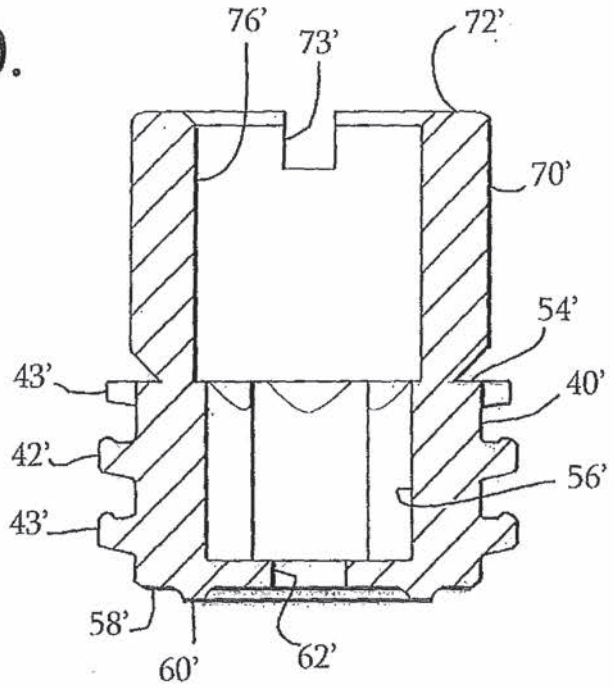

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Fig. 11.

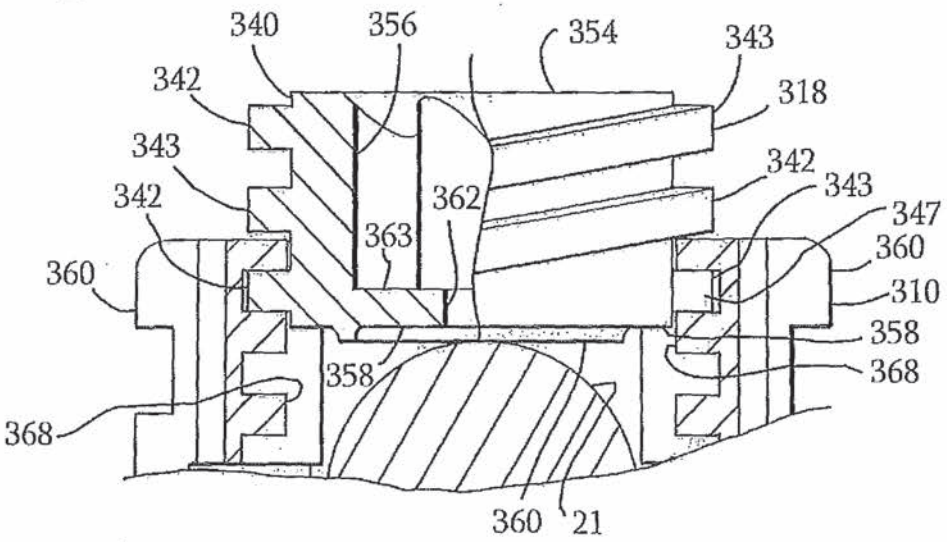

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Fig. 12.

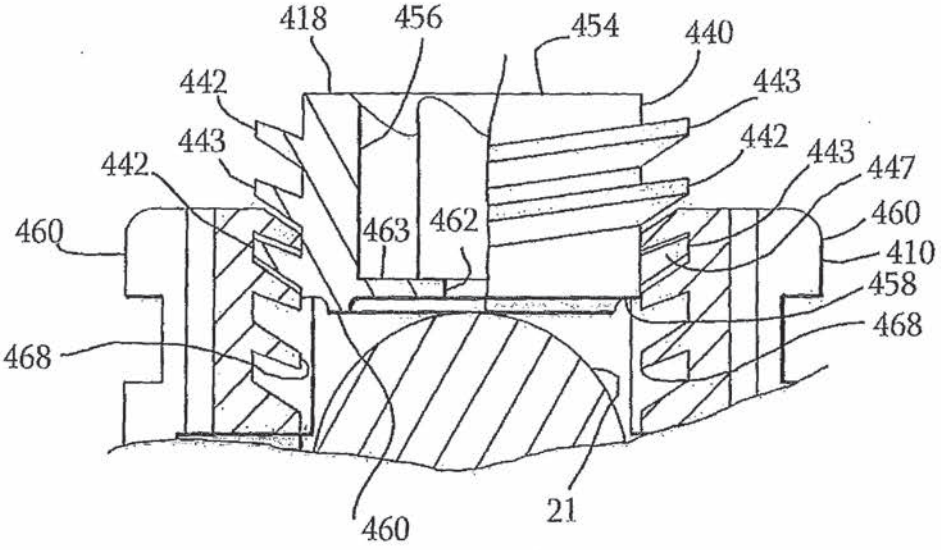

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Fig. 13.

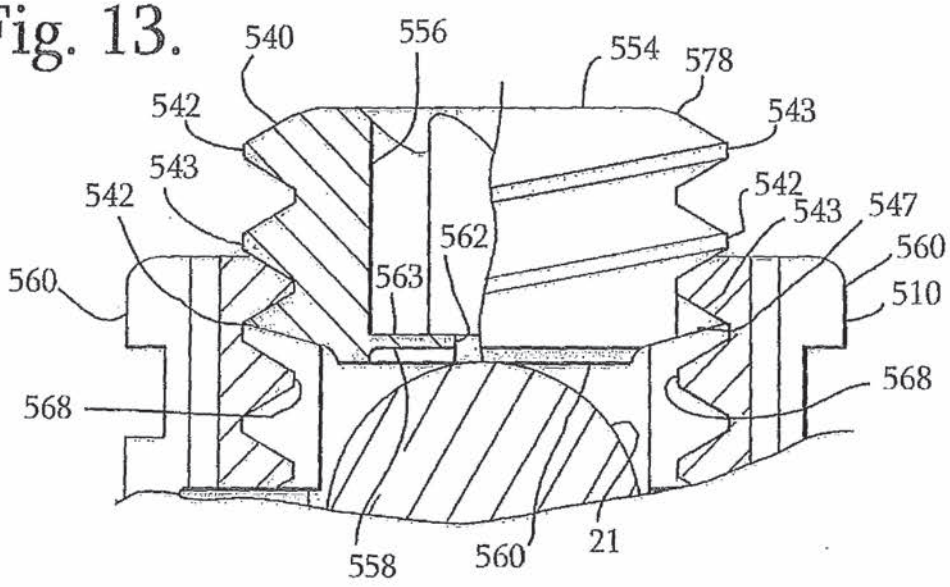

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Fig. 14.

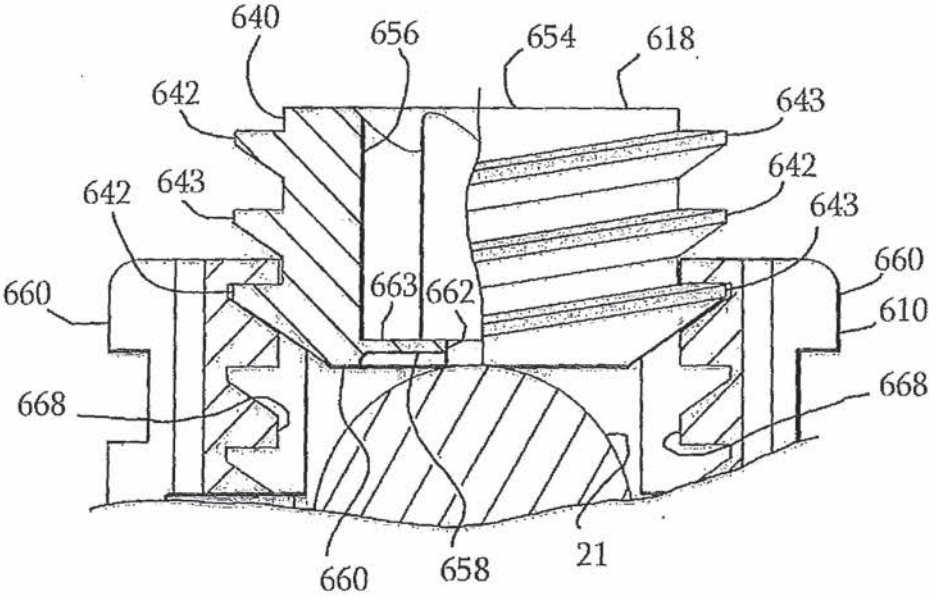
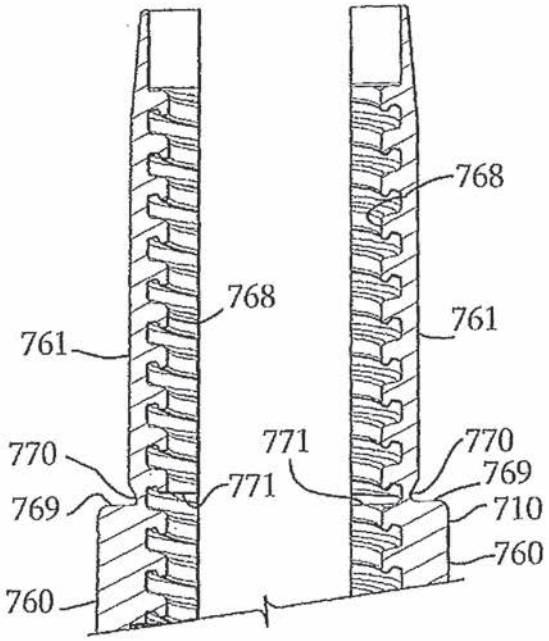

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Fig. 15.



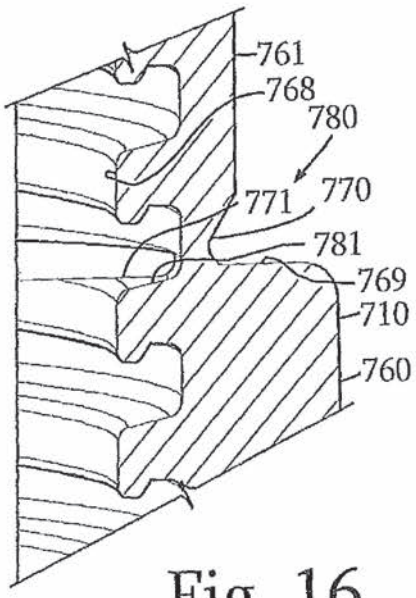


Fig. 16.

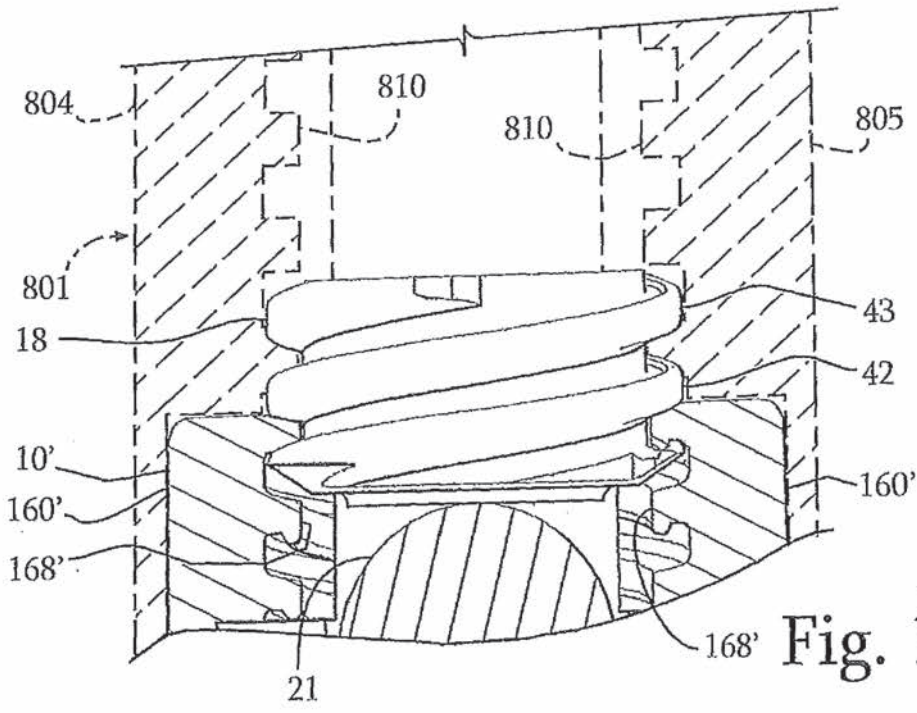


Fig. 17.

Fig. 18.

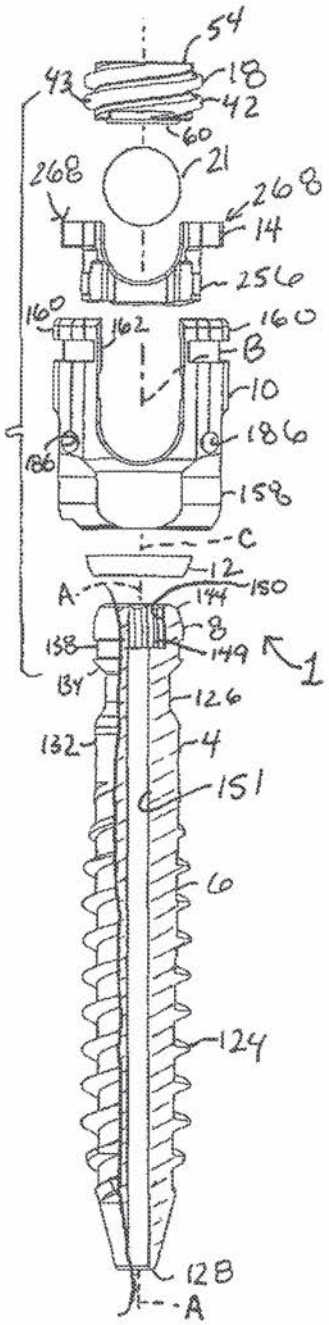


Fig. 19.

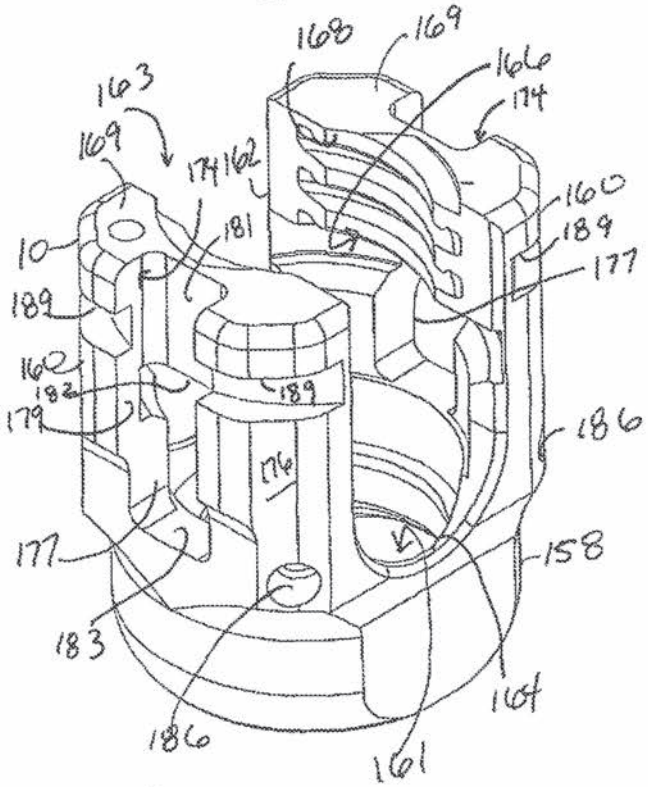


Fig. 20.

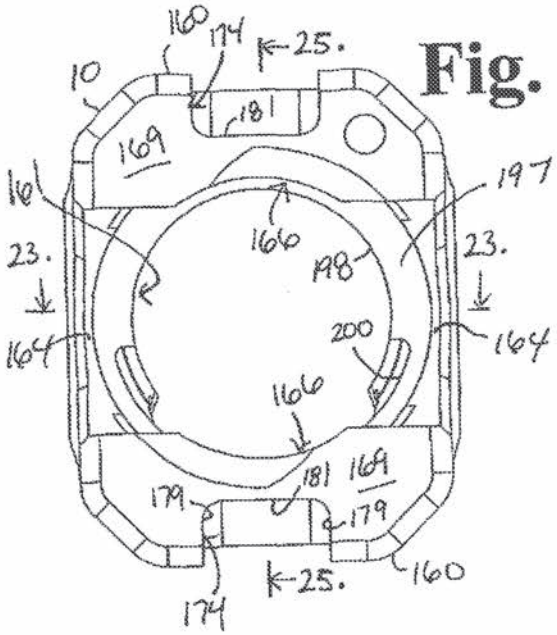


Fig. 21.

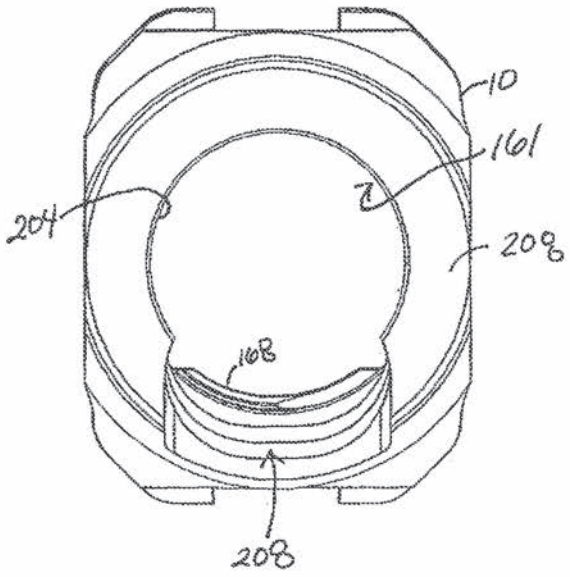


Fig. 22.

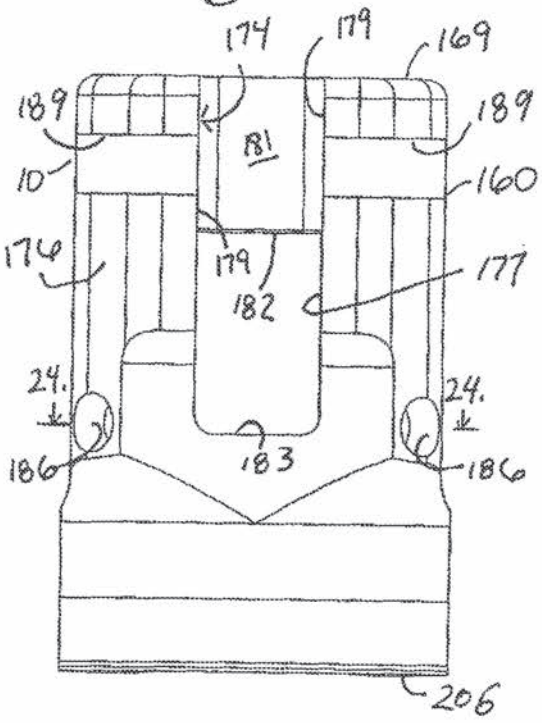


Fig. 23.

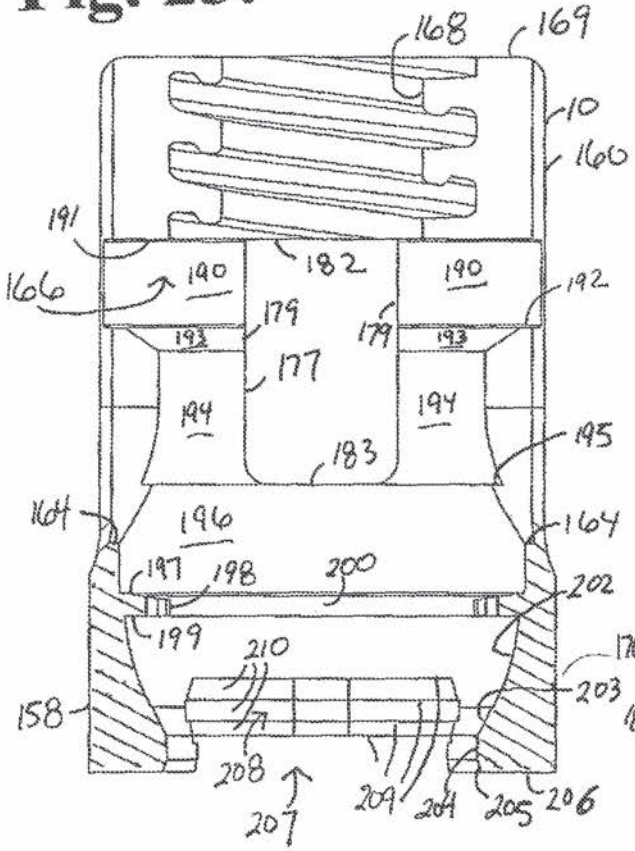


Fig. 24.

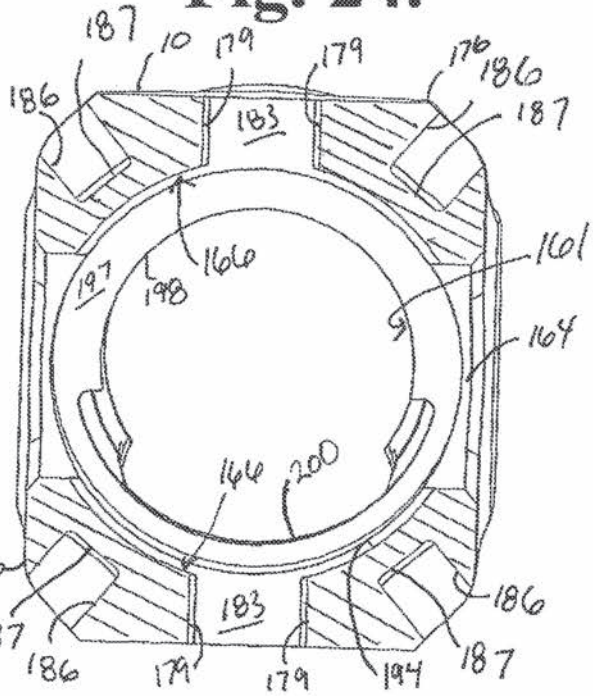


Fig. 25.

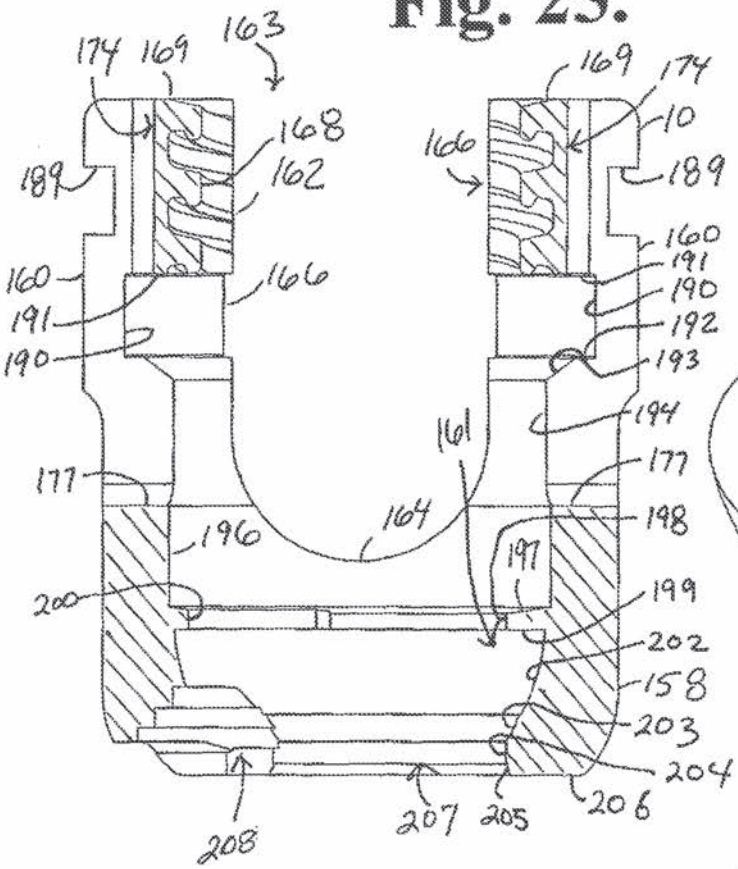


Fig. 26.

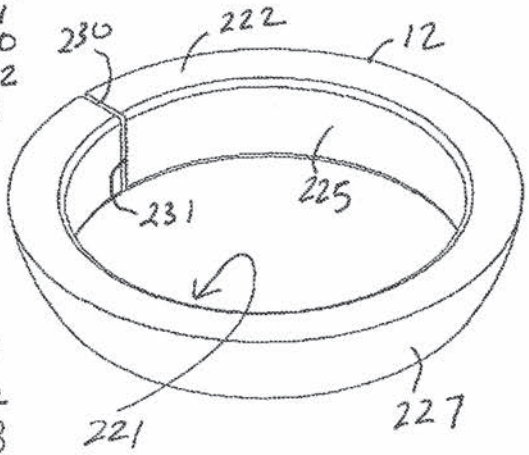
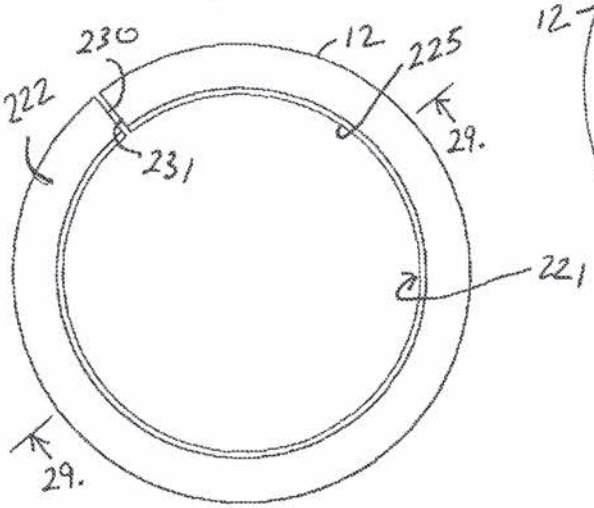


Fig. 27.



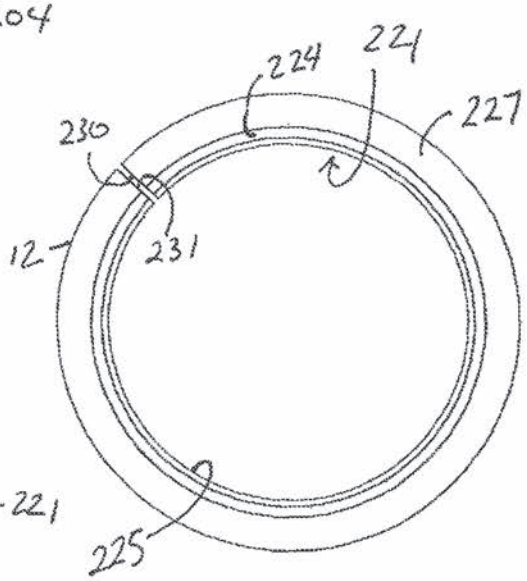
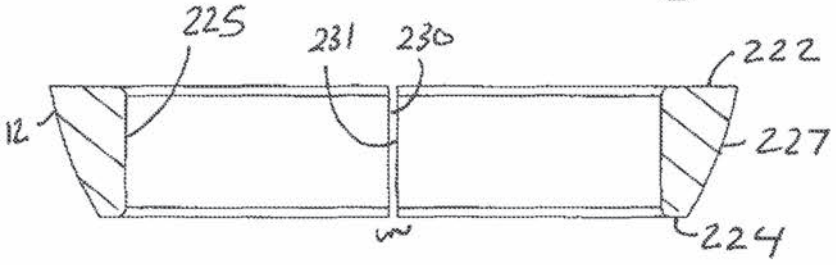


Fig. 28.

Fig. 29.



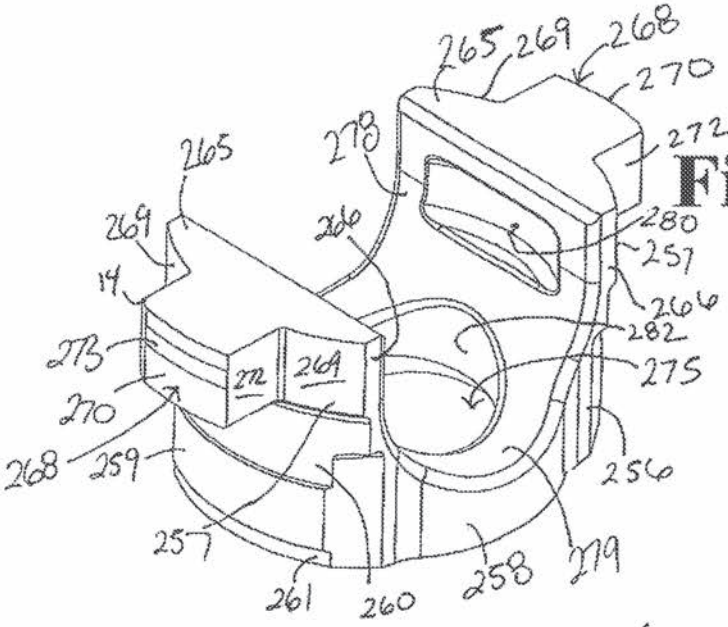


Fig. 30.

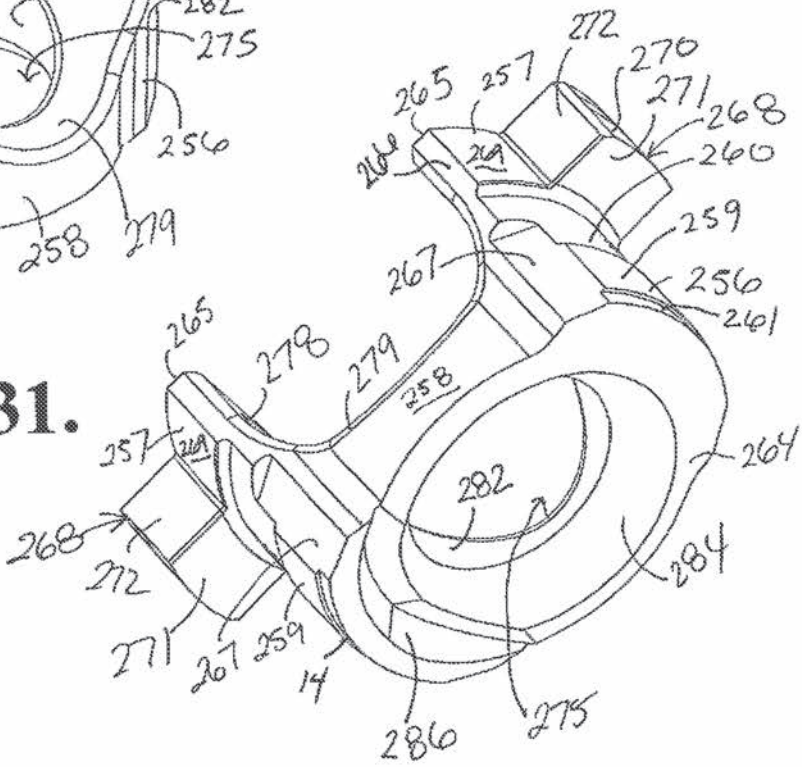


Fig. 31.

Fig. 32.

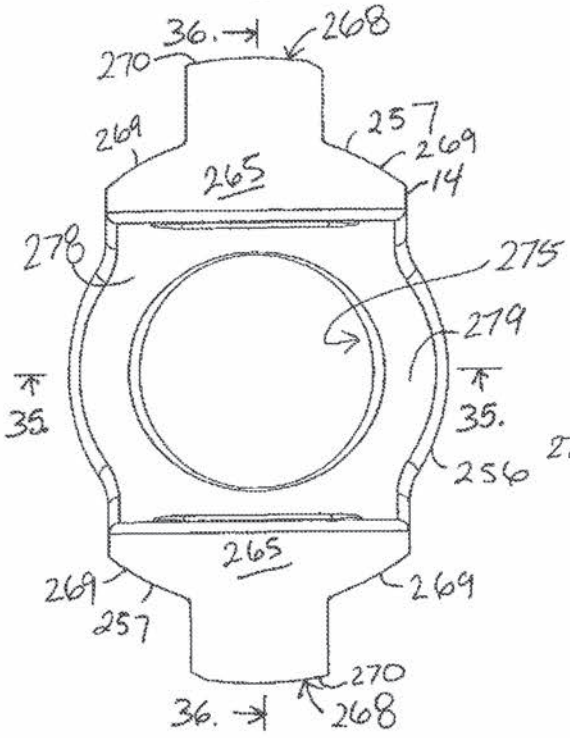


Fig. 33.

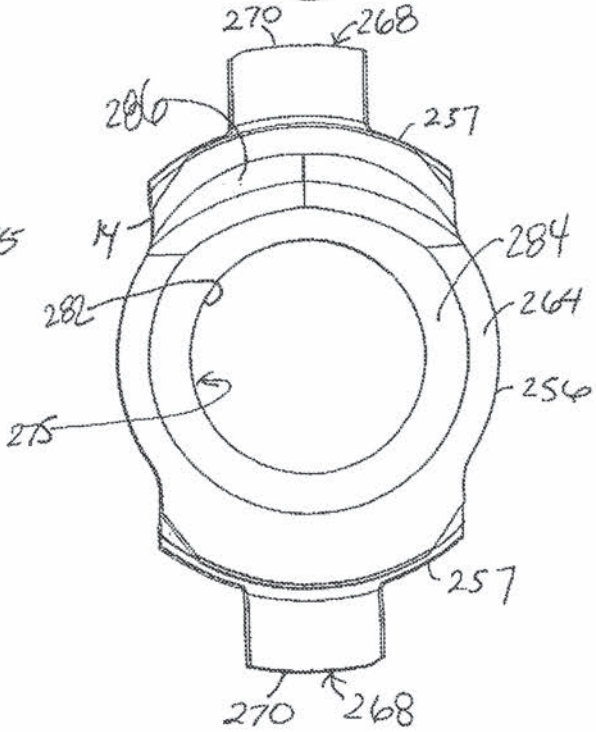


Fig. 34.

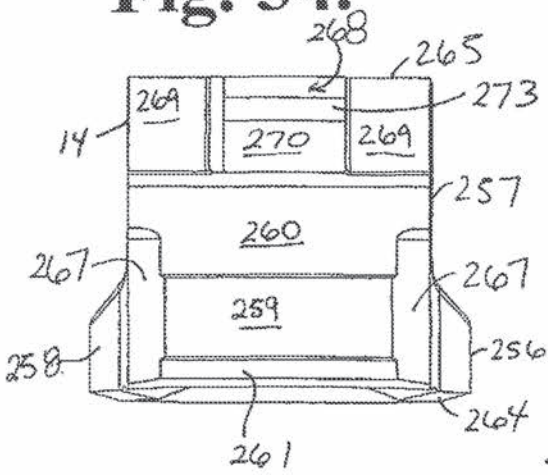
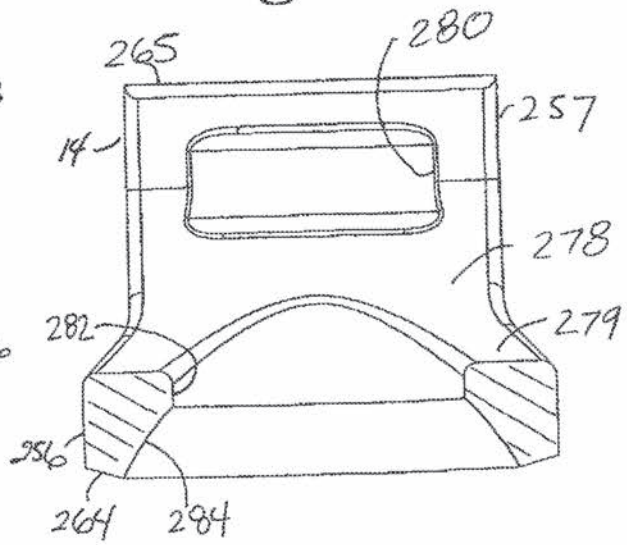


Fig. 35.



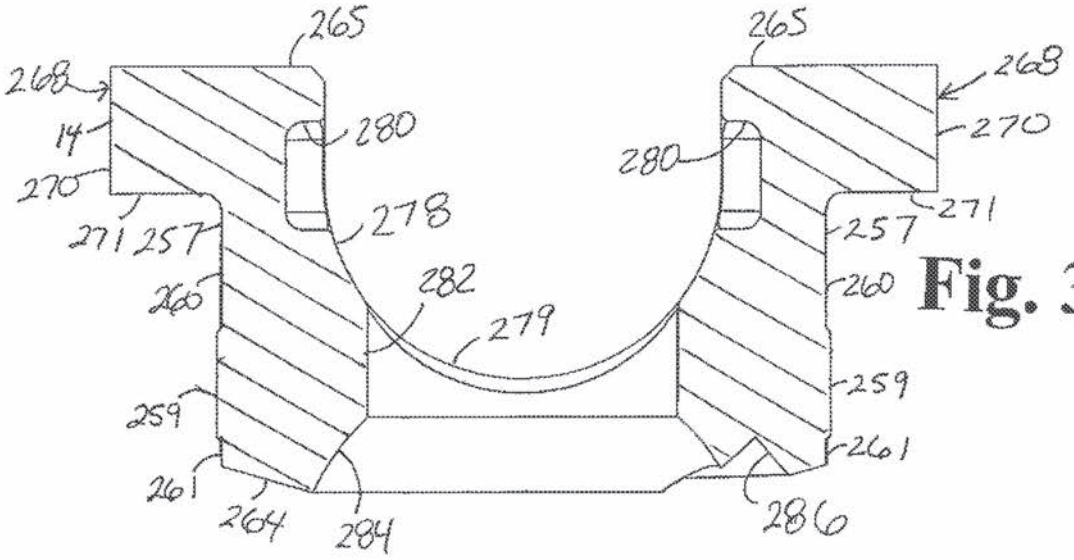


Fig. 36.

Fig. 37.

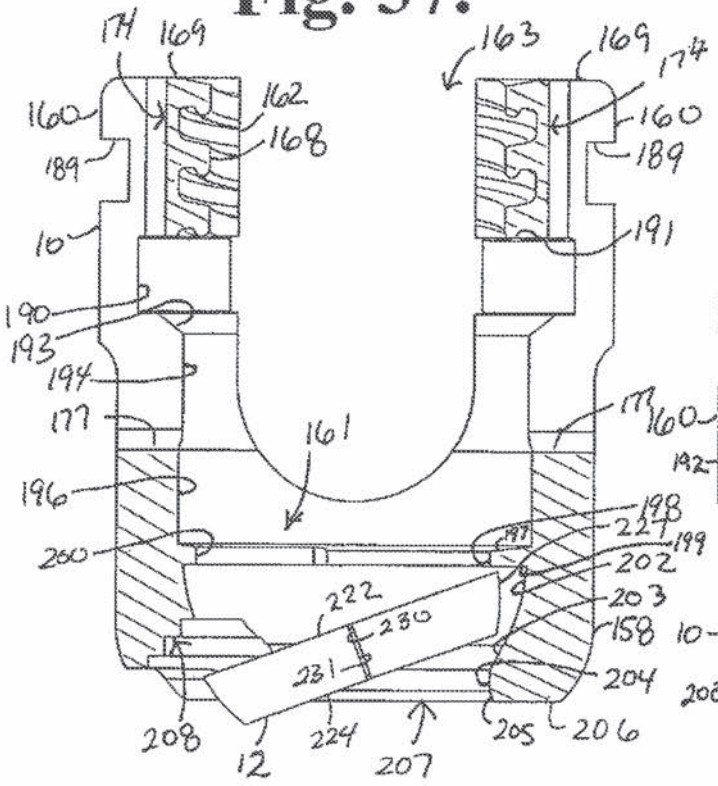


Fig. 38.

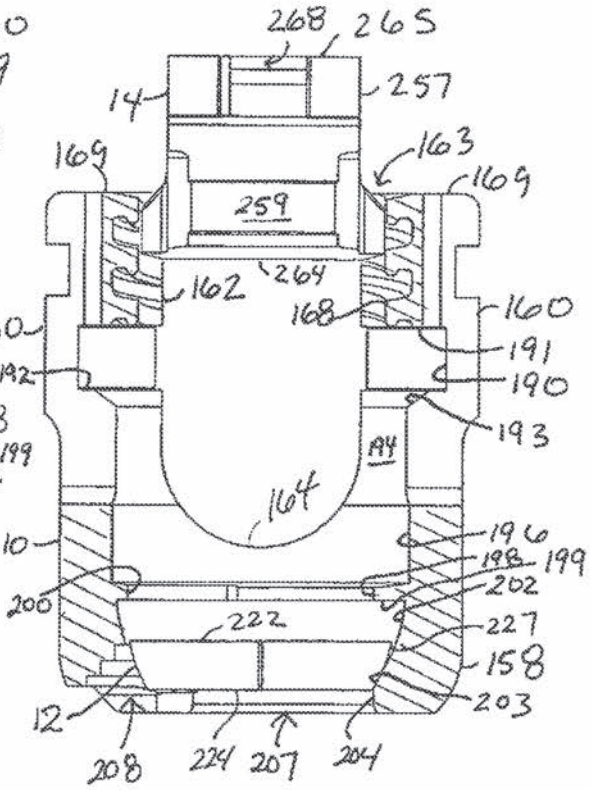


Fig. 39.

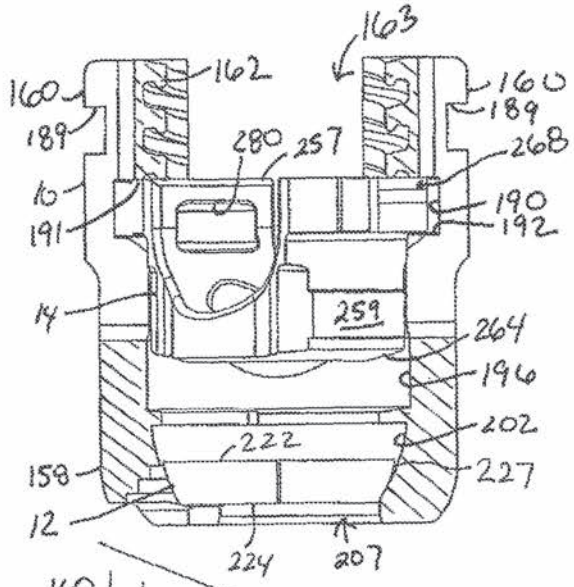


Fig. 40.

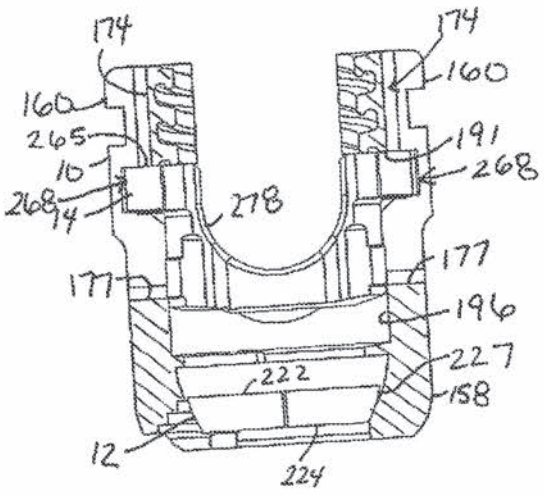


Fig. 41.

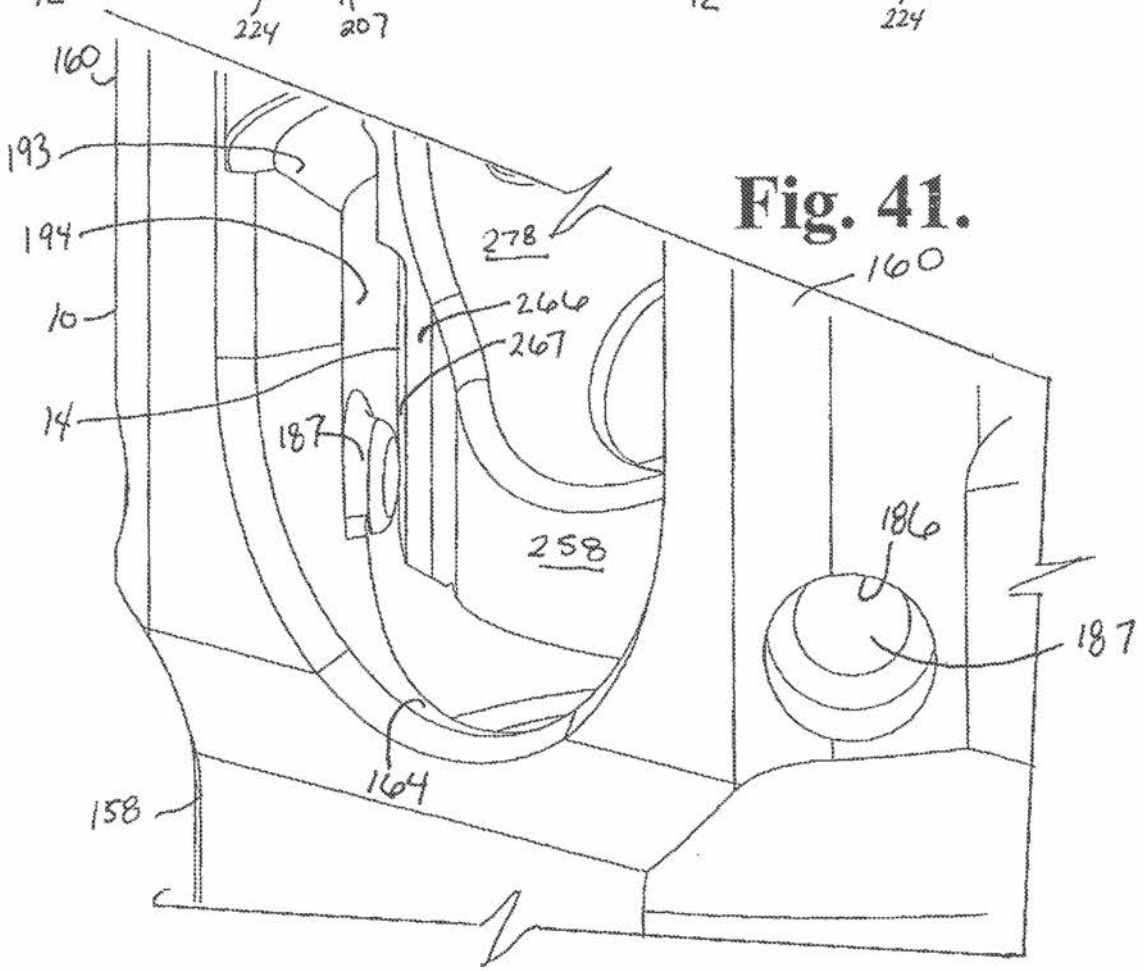


Fig. 42.

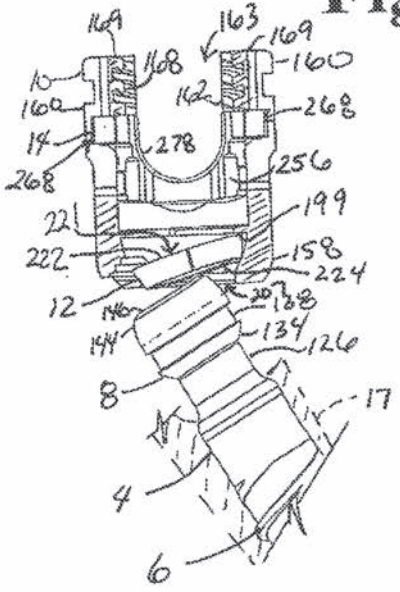


Fig. 43.

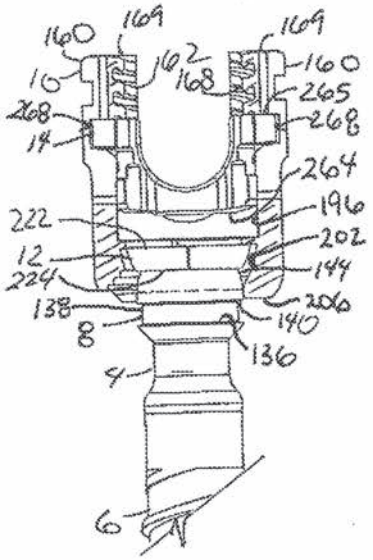


Fig. 44.

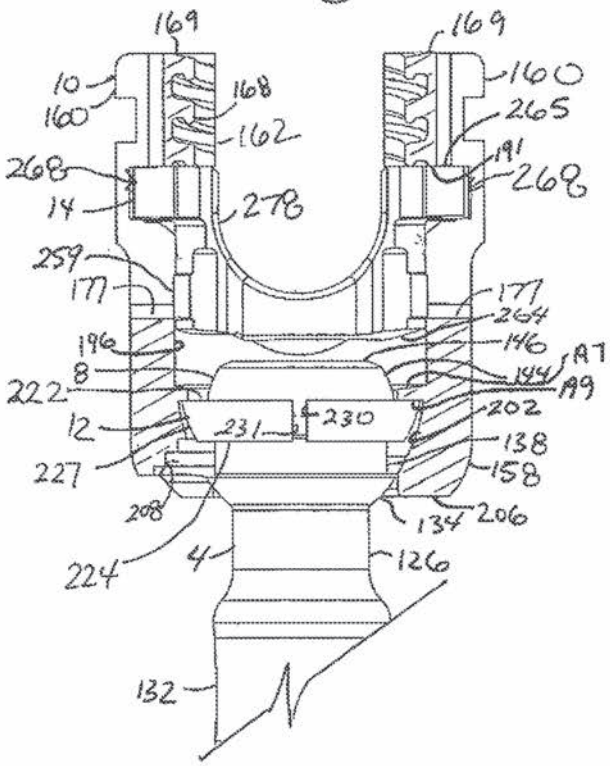


Fig. 45.

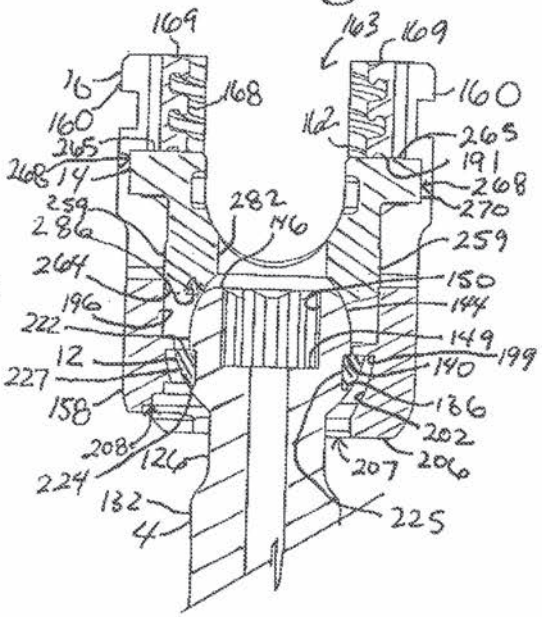


Fig. 46.

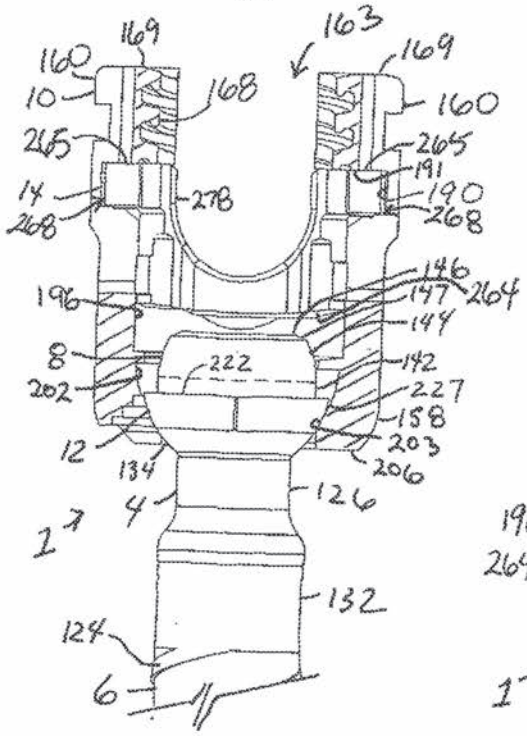


Fig. 47.

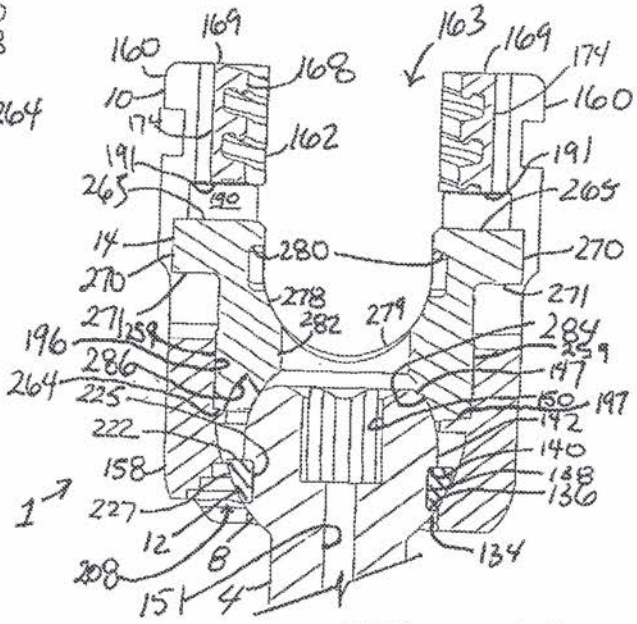


Fig. 48.

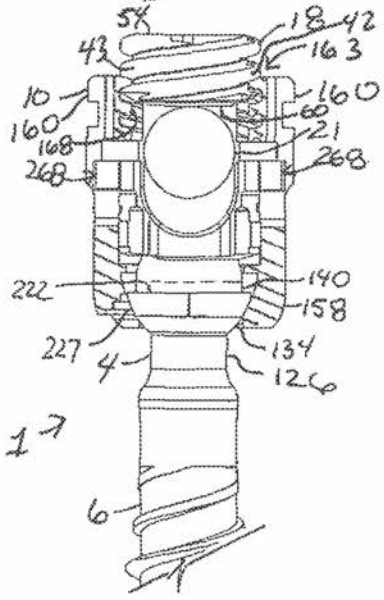


Fig. 49.

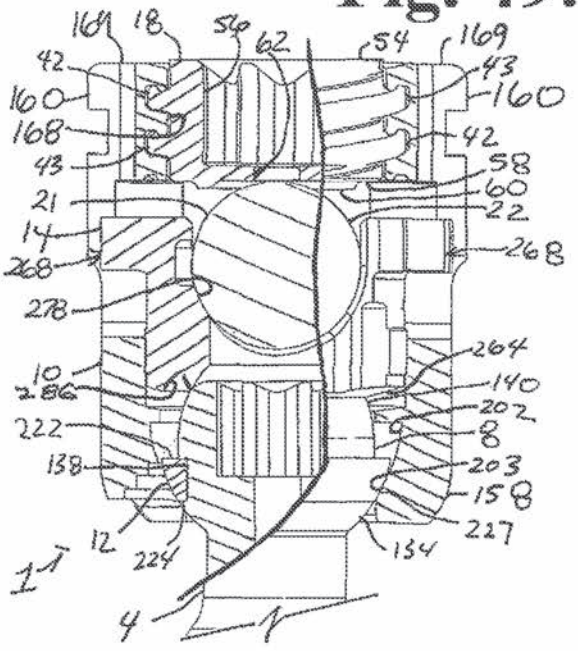


Fig. 50.

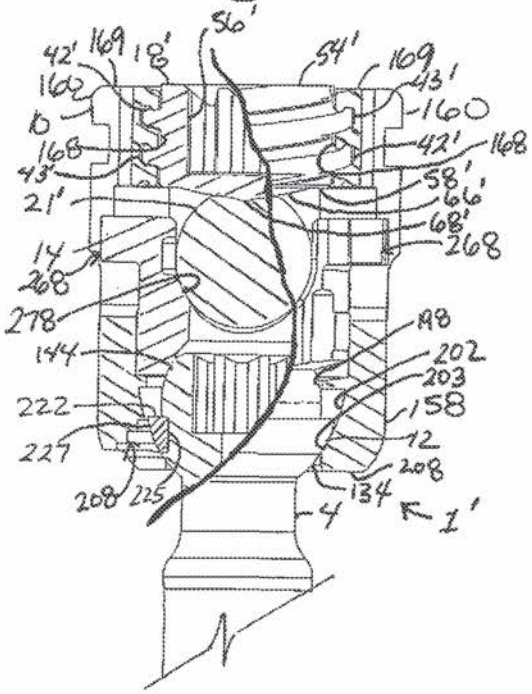


Fig. 51.

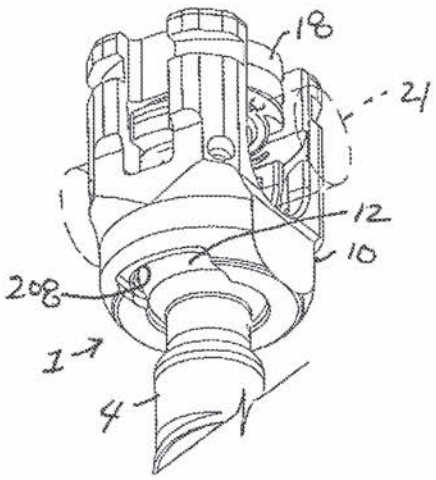


Fig. 52.

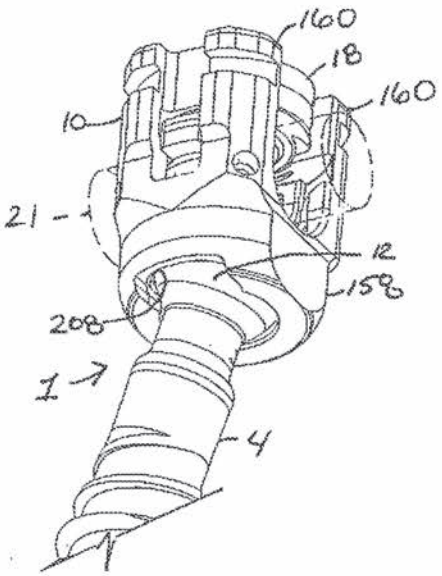


Fig. 53.

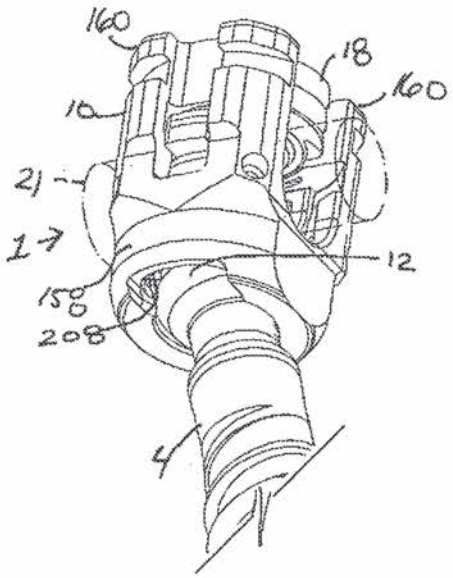


Fig. 54.

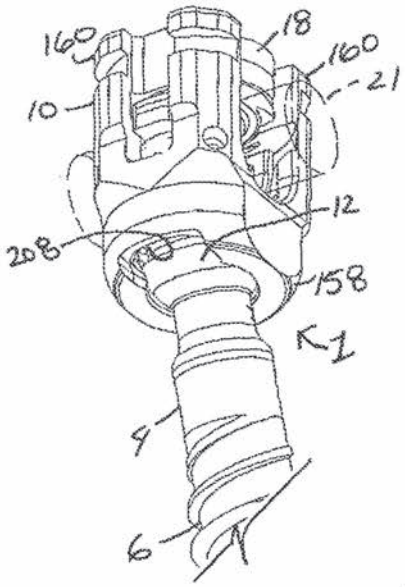


Fig. 55.

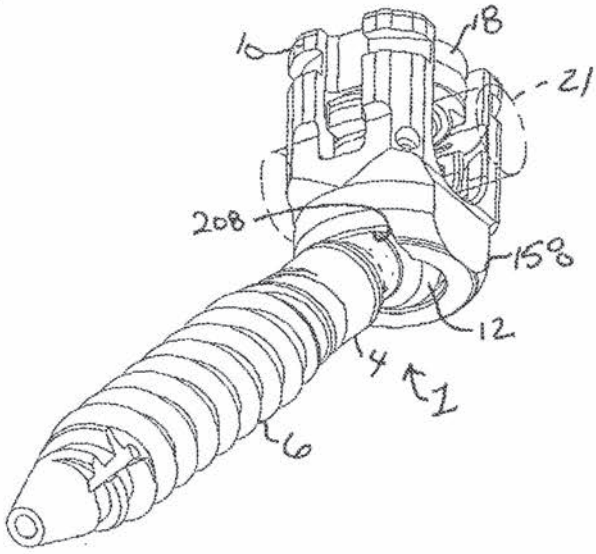


Fig. 56.

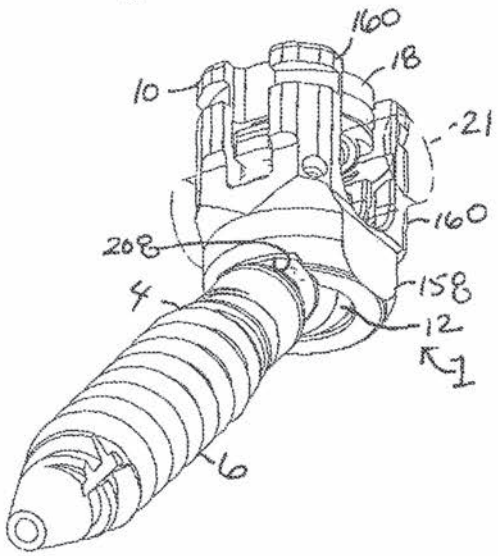


Fig. 57.

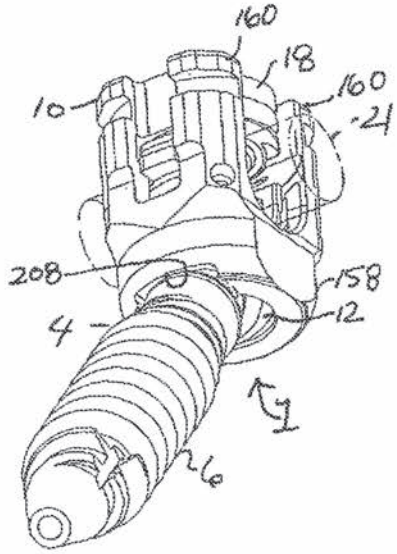
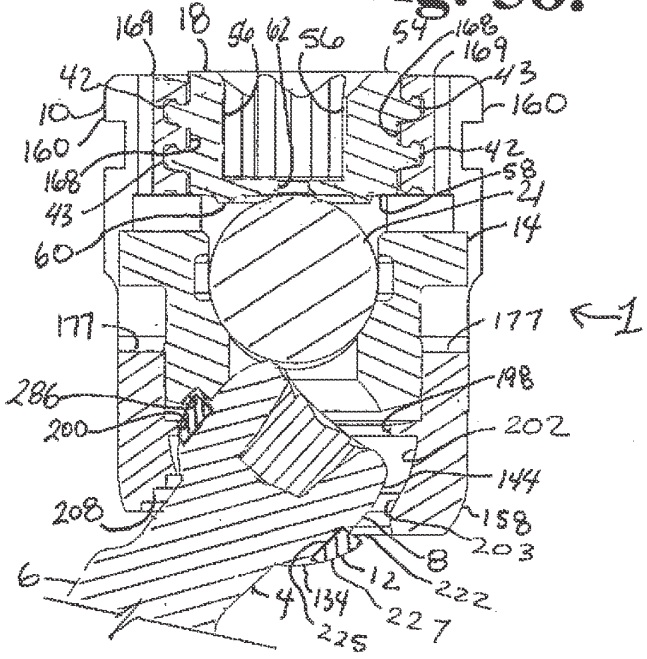


Fig. 58.


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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: TBD	Confirmation No.	:	
First Applicant	: Roger P. Jackson	Art Unit	:	
Filed	: Herewith	Examiner	:	
Title	MEDICAL IMPLANT THREADED CLOSURE HAVING A START STRUCTURE WITH SYMMETRICALLY SHAPED CONCAVE AND CONVEX LEADING SURFACES			
Docket No.	: JAC023-667905			
Customer No.	: 24030	Entity Status	:	Undiscounted

INFORMATION DISCLOSURE STATEMENT
PURSUANT TO 37 C.F.R. §§ 1.56, 1.97, AND 1.98

Commissioner:

The Examiner is respectfully requested to consider the patents, patent applications, publications, or other information cataloged on the enclosed Form PTO/SB/08A during examination of the above-identified patent application. The order of presentation of the references should not be construed as an indication of importance. These references are submitted for the Examiner's consideration and are submitted pursuant to an Applicant's duty of disclosure under 37 C.F.R. § 1.56.

Copies of all of the cited documents

☐ are enclosed unless otherwise indicated on the enclosed Form PTO/SB/08a.

☐ have been previously furnished to the Office in prior application No. _____, filed _____, which the present application relies upon for an earlier effective filing date under 35 U.S.C. § 120. Therefore, no copies of the cited documents are included herewith pursuant to 37 C.F.R. § 1.98(d); MPEP § 609(III)(A)(2).

☒ are enclosed unless they are U.S. patents or U.S. patent application publications pursuant to 37 C.F.R. § 1.98(a).

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I
BASIS

This information disclosure statement is filed pursuant to

☒ 37 C.F.R. § 1.97(b).
This information disclosure statement is filed either (1) within three months of the filing date of a national application other than a continued prosecution application under 37 C.F.R. § 1.53(d); (2) within three months of the date of entry of the national stage as set forth in 37 C.F.R. § 1.491 in an international application; (3) before the mailing date of a first Office action on the merits; or (4) before the mailing of a first Office action after the filing of a request for continued examination under 37 C.F.R. § 1.114, whichever event occurs last.

Accordingly, this information disclosure statement requires no fee and no certification.

☐ 37 C.F.R. § 1.97(c).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(b), but before the mailing date of any of (1) a final action under 37 C.F.R. § 1.113; (2) a notice of allowance under 37 C.F.R. § 1.311; or (3) an action that otherwise closes prosecution in the application.

Accordingly, this information disclosure statement requires either the fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c), or a statement under 37 C.F.R. § 1.97(e).

☐ 37 C.F.R. § 1.97(d).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(c) since a

☐ final action under 37 C.F.R. § 1.113

☐ notice of allowance under 37 C.F.R. § 1.311

was mailed to the Applicant(s) on _____. The issue fee has not been paid herein.

Accordingly, this information disclosure statement requires the fee set forth in 37 C.F.R. § 1.17(p) to consider an information disclosure statement under 37 C.F.R. § 1.97(d), and a statement under 37 C.F.R. § 1.97(e).

If this statement crosses in the mail with an Office action, or is otherwise not in the indicated category of 37 C.F.R. § 1.97, it is respectfully requested that this statement be treated in the next appropriate category and made of record. To the extent required, please treat this paper as a conditional petition for acceptance of the information disclosure statement.

II
FEES

Any required fee is being paid as indicated below by an enclosed check or our deposit account.

☒ No fee is due.

☐ The $____ fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c) or (d) is due.

☐ A check is enclosed for the required fee.

☐ Payment by credit card is submitted simultaneously herewith for the required fee.

☐ Please charge the required fee to our deposit account no. 50-1662.

☐ The Commissioner is hereby authorized to charge any additional required fees or credit any overpayments associated with this information disclosure statement to our deposit account no. 50-1662.

III
CERTIFICATION

Pursuant to 37 C.F.R. § 1.97(e), I state as follows:

☒ No statement is necessary.

☐ Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(1).

☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to my knowledge after making reasonable inquiry, no item of information contained in this information disclosure statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(2).

Pursuant to 37 C.F.R. § 1.704(d), I state as follows:

☐ Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart application, and this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this information disclosure statement.

IV
FOREIGN LANGUAGE REFERENCES

Pursuant to 37 C.F.R. § 1.98(a)(3)(i), any information disclosure statement filed under 37 C.F.R. § 1.97 shall include a concise explanation of the relevance, as it is presently understood by the individual designated in § 1.56(c) most knowledgeable about the content of the information, of each patent, publication, or other information listed that is not in the English language. The concise explanation may be either separate from the specification or incorporated therein. In compliance with the rules, the Applicant states as follows:

☐ No concise explanation is required since all cited references are in English.

☐ A concise explanation of the relevance of one or more foreign language references is attached.

☐ No English language version was available for one or more foreign language references.

☒ According to the procedural policy adopted by the PTO with regard to disclosure requirements, the Applicant is satisfying the disclosure requirement pursuant to MPEP § 609.04(a)(III) by submitting herewith the following:

- ☒ An English language version of one or more non-English language documents.
- ☐ An English language equivalent application or patent of one or more non-English language applications or patents.
- ☐ An English language version of one or more search reports or other actions by one or more foreign patent offices in one or more counterpart foreign applications, which indicate the degree of relevance found by the foreign office(s).
- ☒ An English language abstract of one or more non-English language references.

The Applicant has not analyzed these documents and, therefore, declines to comment on their relevance at this time.

V
REMARKS

☐ Pursuant to the doctrines established by the Court of Appeals for the Federal Circuit in *McKesson Information Solutions, Inc. v. Bridge Medical, Inc.*, 487 F.3d 897 (Fed. Cir. 2007) and *Dayco Products, Inc. v. Total Containment, Inc.*, 329 F.3d 1358 (Fed. Cir. 2003), Applicant(s) submit documents herewith reflecting the prosecution history of applications that Applicant(s) believe may be considered related to the present application.

☒ In satisfaction of the duty of disclosure under 37 C.F.R. § 1.56, and as required by M.P.E.P. § 2001.06(b), the Examiner is requested to consider the pending U.S. patent applications listed in "Attachment A," which are owned by the Assignee of the present

application. The pending patent applications may include subject matter similar to that of the present application.

It is respectfully requested that

(1) the Examiner sign the enclosed Form PTO/SB/08a to evidence that the cited information has been fully considered by the Patent and Trademark Office during the examination of this application; and

(2) the citations for the cited information be printed on any patent that issues from this application.

The submission of this information disclosure statement by the Applicant(s) shall not be construed as a representation that a search has been performed or that no other material information under 37 C.F.R. § 1.56 exists. See 37 C.F.R. § 1.97(g).

The submission of this information disclosure statement by the Applicant(s) shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, material to the patentability of one or more of the pending claims in this application pursuant to 37 C.F.R. § 1.56(b), unless specifically designated by the Applicant(s) as such. See 37 C.F.R. § 1.97(h).

The submission of this information disclosure statement by the Applicant(s) shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, or even qualifies as "prior art" under 35 U.S.C. § 102 with respect to this invention, unless specifically designated by the Applicant(s) as such.

Notwithstanding any statements by the Applicant(s), the Examiner is urged to form his or her own conclusion regarding the relevance of the cited information.

VI
CONCLUSION

The Examiner is encouraged to contact the undersigned attorney to discuss any questions concerning this information disclosure statement or any of the information cited or referred to herein.

Respectfully submitted December 16, 2020

/ Joshua J. Pranckun /

Joshua J. Pranckun, Registration No. 70712
Attorney for Assignee
USPTO Customer No.

Polsinelli PC
1401 Lawrence Street
Suite 2300
Denver, CO 80202
Phone: (303) 583-8469
Fax: (303) 942-3621

ATTACHMENT A
APPLN. NO. TBD
INFORMATION DISCLOSURE STATEMENT
FOR
STATEMENT UNDER MPEP § 2001.06(b)

U.S. PATENT DOCUMENTS			
Examiner Initials	**Patent No.**	**Issue Date**	**Name of Patentee or Applicant of Cited Document**
	8,377,100	02/19/2013	Jackson
	9,636,146	5/02/2017	Jackson et al.
	9,717,533	8/01/2017	Jackson et al.
	9,743,957	8/29/2014	Jackson
	9,861,394	1/09/2018	Jackson
	10,004,541	6/26/2018	Jackson
	10,206,716	02/19/2019	Jackson et al.

U.S. PUBLICATION DOCUMENTS			
Examiner Initials	**Publication No.**	**Publication Date**	**Name of Patentee or Applicant of Cited Document**
	2014/0214097	7/31/2014	Jackson et al.
	2015/0119942	4/30/2015	Jackson et al.
	2015/0148846	5/28/2015	Jackson
	2015/0164558	6/18/2015	Jackson et al.
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	2017/0189073	7/06/2017	Jackson et al.
	2017/0333083	11/23/2017	Jackson et al.
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	2017/0354441	12/14/2017	Jackson et al.
	2018/0243013	08/30/2018	Jackson et al.
	2018/0296249	10/18/2018	Jackson
	2019/0231400	08/01/2019	Jackson et al.
	2019/0175225	06/13/2019	Jackson et al.
	2019/0274734	09/12/2019	Jackson et al.
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	2020/0163702	05/28/2020	Jackson et al.
	2020/0179014	06/11/2020	Jackson

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U.S. APPLICATION DOCUMENTS			
Examiner Initials	Application No.	Filing Date	Name of Patentee or Applicant of Cited Document
EXAMINER		DATE CONSIDERED	
EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.			

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PTO/SB/08A (08-03) U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE Substitute for Form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	**APPLICATION NO.:** TBD	**FILING DATE:** Herewith
	INVENTOR(S): Roger P. Jackson	**ART UNIT:**
	EXAMINER NAME:	**ATTY. DOCKET NO.:** JAC023-667905

U.S. PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PATENT NUMBER Number – Kind Code[2] (if known)	ISSUE DATE MM-DD-YYYY	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A1.	2,005,348	06-1935	Michell	
	A2.	2,833,325	05-1958	Laisy	
	A3.	3,963,322	06-1976	Gryctko	
	A4.	4,600,225	07-1986	Blose	
	A5.	5,067,955	11-1991	Cotrel	
	A6.	5,092,635	03-1992	DeLange et al.	
	A7.	5,234,430	08-1993	Huebner	
	A8.	5,334,203	08-1994	Wagner	
	A9.	5,605,458	02-1997	Bailey et al.	
	A10.	5,607,304	03-1997	Bailey et al.	
	A11.	5,672,176	09-1997	Biedermann et al.	
	A12.	5,797,911	08-1998	Sherman et al.	
	A13.	6,006,930	12-1999	Dreyer et al.	
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	A15.	6,063,090	05-2000	Schlapfer	
	A16.	6,077,262	06-2000	Schlapfer et al.	
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	A18.	6,254,146	07-2001	Church	
	A19.	6,296,642	10-2001	Morrison et al.	
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	A21.	6,520,962	02-2003	Taylor et al.	
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	A23.	6,730,089	05-2004	Jackson	
	A24.	6,835,196	12-2004	Biedermann et al.	
	A25.	6,997,927	02-2006	Jackson	
	A26.	7,204,838	04-2007	Jackson	
	A27.	7,717,942	05-2010	Schumacher	
	A28.	7,591,839	09-2009	Biedermann et al.	
	A29.	7,794,477	09-2010	Melkent et al.	
	A30.	7,972,364	07-2011	Biedermann et al.	
	A31.	8,382,809	02-2013	Kaufman et al.	
	A32.	8,814,913	08-2014	Jackson	
	A33.	8,911,479	12-2014	Jackson et al.	
	A34.	9,068,587	06-2015	Sage et al.	

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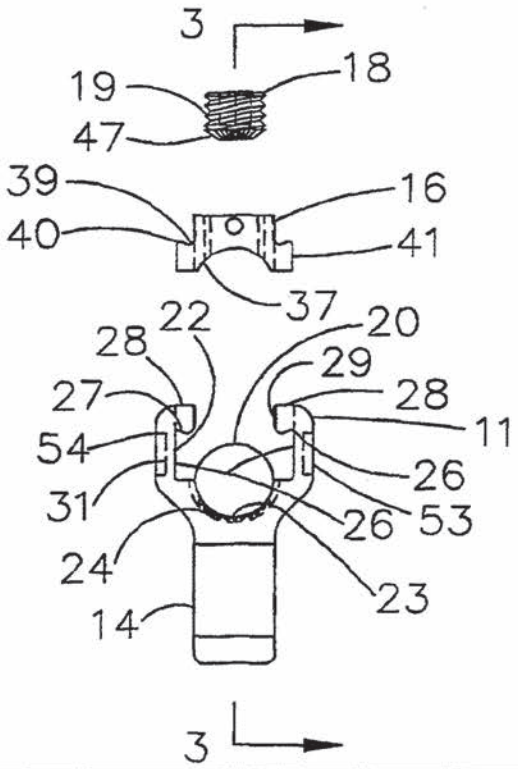
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(54) Title: ROD ANCHOR SEAT HAVING SLIDING CLOSURE MEMBER

(57) Abstract

A spinal implant assembly is provided having a top loading anchor (11) which is fixed to a spinal member by a hook (14). The anchor (11) includes a seat member (12) having a channel (22) to receive a stabilizer rod (20) and a sliding interconnecting closure member (16) which slides in a longitudinal direction relative to the seat member (12) to form an integral closed implant assembly. The closure member (16) includes retaining flanges (41) which dovetail relative to undercut retaining flanges (28) of the seat member (12) so as to prohibit the sliding closure member (16) from being dislodged from the seat channel (22), as well as inhibit the splaying of the seat member (12) in response to forces which may be imposed upon the seat member (12) during de-rotation of the spine. In addition, the seat member (12) includes a set screw (18) for locking the rod (20) in position relative to the anchor (11). An instrument (78) is provided which has a spring loaded ball plunger (89) for holding the closure member (16) during assembly to the seat member (12).



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ROD ANCHOR SEAT HAVING SLIDING CLOSURE MEMBER

FIELD OF INVENTION

This invention relates to orthopedic implants, and more particularly to a bone interface anchor for holding a stabilization rod. The anchor can be adjusted after implantation to receive a stabilizer, and is locked into position after assembly.

BACKGROUND

As surgical techniques have advanced, it has become increasingly common for surgeons to use specially designed hardware for the internal fixation of bones. A particular area of concentration for the recent development of this technology has been the spine. Internal fixation is used most frequently in the spine in conjunction with vertebral fusion, and also for the manipulation of the spine to correct spinal deformities such as scoliosis.

There are several important criteria for a hardware system which is used for internal fixation:

1. The implant should provide rigidity as is indicated, generally along the long axis of the patient's spine.

2. The system should be able to accommodate a broad variation in the size and shape of the spinal member with which it is used. For example, the surgeon may wish to use the implant on a variety of individuals. In addition, the difference in the area and size of the point of fixation is compounded by the change in the shape of the vertebrae over the length of the full spinal column. Since it is an advantage to allow the surgeon to master implanting a particular type of assembly, it is preferable if the same or similar anchoring means can be used for a variety of locations. This advantage results in cost efficiency of inventory as well as efficiencies with respect to minimizing the operating time.

3. The hardware must be able to apply and

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oppose considerable stresses and strains. Thus, the anchor means must be securely fixed to the bone, and the stabilizer must be securely fixed with regard to the anchor means. Moreover, it is desirable to have the integrity to resist breaking.

4. The system should be designed for ease of implantation and removal. Implant hardware is relatively small and therefore somewhat difficult to manipulate. Any difficulty with assembly is compounded by the fact that the assembly occurs during surgery and in a living being. Therefore, it is critical that the hardware is designed with the surgeon's convenience in mind, i.e., to limit the time required and the stress required to implant an assembly. Consequently, a fixation system should be designed to the extent possible for easy assembly while maintaining the option of removal where necessary.

SUMMARY OF THE INVENTION

The present invention relates to a top- loading rod anchor which has an interlocking sliding member to close the anchor about the rod. The anchor assembly in the present invention includes an anchor having a center slot to allow insertion of the sliding member from the center. The slot includes a lateral undercut which mates with the flanges on the sliding member.

Accordingly, it is an object of the present invention to provide a vertebral anchor means which is top-loading, but which converts to a two-piece closed anchor for derotation of the spine. Closed anchor refers to an anchor which at least substantially partially includes the rod so that the anchor means will withstand hoop stresses introduced by manipulating the rod within the anchor. It is a further object of the invention to provide a sliding interconnecting member which cooperates an said anchor seat means by an axially sliding and which has a positive stop which removably locks said sliding member into cooperation with said anchor means.

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BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is an exploded side view of the implant assembly in accordance with the present invention;

Figure 2 is an exploded front view of the implant assembly in accordance with the present invention;

Figure 3 is a cross-section of the assembled components of Figure 1 taken along line 3-3 of Figure 2;

Figure 4 is a cross-section of the assembled components taken along line 4-4 of Figure 1;

Figure 5 is a top view of the sliding interlocking seat closure member as shown in Figure 1;

Figure 6 is a cross-section of the closure member taken along line 6-6 of Figure 5;

Figure 7 is a cross-section of the sliding member taken along line 7-7 of Figure 5; and

Figure 8 is a top plan view of the anchor used with the implant assembly of Figure 1;

Figure 9 is a side cross-sectional view taken along line 9-9 of the anchor of Figure 8;

Figure 10 is a front cross-sectional view taken along line 10-10 of the anchor of Figure 8; and

Figure 11 is an instrument for the alignment and implantation of the sliding interconnecting rod closure member as shown in Figures 1-4.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 illustrates an exploded side view of the spinal implant assembly of the present invention. The implant assembly 10 comprises a stabilization means, i.e., rod 20, and an implant anchor 11. The anchor includes a seat 12 which is fixed to the spine by fixation means, in this case, a hook 14. However, the invention could also be practiced with other fixation means such as a bone screw. The seat 12 includes a recess 23 which receives the rod about its longitudinal axis and which is loaded from the top of the seat. The seat is closed by a sliding

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interconnecting closure member 16 which has a sliding interlocking engagement with seat member 12. More specifically, the closure member 16 is dropped into an engagement on the rod 20 and slid in a direction along the rods' longitudinal axis so as to form an interlocking engagement with the seat 12. A set screw 18 cooperates with the closure member to apply a compressive force on the rod and secure the rod relative to the seat member.

The seat 12 includes a channel 22 which has in its bottom a rod recess 23 which is contoured to accept the rod 20. Optionally, the rod recess 23 may include a surface interface so as to increase the compressive interface between the rod 20 and the seat, such as interrupted serrations.

The channel 22 includes in its upper portion a recess 26 which is formed on the inside of a seat shoulder 27. In addition, the flange members 28 which form the seat shoulder 27 include a slight protuberance 29 which mates with grooves 30 on the closure member 16 to bias the closure member 16 into position with regard to the seat member 12. The seat member includes a cutouts 43 in the flange members 28 which enables the sliding closure member 16 to be loaded into the seat 12 from a central position with a small sliding movement, in contrast to sliding the closure member along the entire length of the channel 22 from either direction.

The anchor 11 also includes a closure member 16 which acts with the seat 12 to present a closed anchor 11 which facilitates the manipulation and specifically, the derotation of the spine. Since the closure member has a dove-tailed relationship with the seat member 12 to allow a sliding interlocking engagement. The seat member 12 may be loaded from the top with the rod 20 and subsequently closed with the closure member 16 so as to fix the rod relative to the fixation means, but to allow rotation of the rod about its longitudinal axis. The closure member 16 includes projecting flanges 41 which have include a

recess 39 on their upper surface, and a sliding shoulder 40 outward from the recess 39. The shoulders 40 of the closure member 16 form a dove-tailed cooperation with the shoulders 27 of the seat member, which cooperation inhibits the sliding closure member from being pulled out of the channel 22 of the seat member 12, and further which inhibits the sides 53, 54 of the seat member which form the channel 22 from splaying in response to a rotational force applied to the rod and cap member, respectively.

The closure member further includes a curved or arched rod interface surface 37 which mates with the top surface of the rod 20. The closure member 16 includes a hole 33 which is threaded with internal threads 34 to receive a set screw 18 having external threads 19. Thus, the set screw 18 can be screwed down relative to the closure member 16 to form a compressive interface with the rod 20. It is a further advantage that the set screw 18 includes a bevel 47 having serrations 48 and a countersink 49 to inhibit the stripping of the set screw and seat threads, as well as improve the compressive grip of the set screw on the rod 20.

In addition, the sliding member has opposing cutout sections 42 corresponding to the cutout section 43 of the seat member to facilitate an intermediate loading of the sliding closure member 16 relative to the seat 12. The seat member 12 has multiple grooves 30 which receive the protuberance 29 of the seat to cause a friction lock between the closure member and the seat member, which lock can be overcome by sliding the closure member along the longitudinal axis of the rod. The closure member has opposing retaining dimples on its front and rear surface which facilitate the assembly of the closure member relative to the seat using an instrument 78 shown in Figure 8 of the present application. In addition, the set screw has a hex opening 46 to allow the set screw to be driven into engagement with the rod 20 using a hex driver.

An instrument 78 is shown for assembly of the

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closure member relative to the seat member and includes a handle 80 an 82 shaft of a length appropriate to allow the surgeon access to the implant, and a pronged instrument head 84. The head 84 includes an opening 86 of a size appropriate to receive the closure member 16, which opening 86 is defined first and second arms 85. The first and second arms respectively include a boss 88 and a spring loaded plunger ball 89. The ball is held in engagement relative to the closure member 16 by biasing means 90.

While in accordance with the Patent Statutes, the best mode and preferred embodiment has been set forth, the scope of the invention is not limited thereto, but rather by the scope of the attached claims.

WHAT IS CLAIMED IS:

1. A retaining member for use with an elongated stabilizer for a spine, said holding means comprising:

a seat having a channel, said channel having an axis in a first direction, said channel receiving said elongated stabilizer so that the longitudinal axis of said stabilizer is aligned in said first direction, and a sliding closure member, said closure member having a sliding cooperation with said seat whereby said closure member may be slid in the first direction to engage said seat, and said seat including means to retain said closure member from disengagement from said channel.

2. A retaining member as set forth in claim 1, wherein said anchor closure member includes a rod interface surface which cooperates with less than all of the circumference of said rod.

3. An member as set forth in claim 2, wherein said closure member has a rod interface surface which extends through a range of less than about 270 degrees.

4. A member as set forth in claim 1, wherein said closure member has a dove-tailed cooperation with said seat.

5. A member as set forth in claim 4, wherein said seat includes first and second seat mating shoulders and said dove tail includes first and second mating shoulder members which mate with the seat mating shoulders inhibit the splaying of said seat means.

6. A member as set forth in claim 1, wherein said seat means includes a central opening to allow said sliding closure means to be engaged with said seat by loading said closure member through said opening and

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sliding it into a locked engagement.

7. An anchor member as set forth in claim 1, wherein said retaining means includes an interlocking biasing friction fit.

8. An anchor means for use with a stabilizer rod comprising a seat having a channel, said channel having a rod receiving recess and being open outwardly of said recess, said channel including a first sidewall and a second sidewall, said first and said second sidewalls terminating in opposing flanges; and

a sliding slide closure member having a rod receiving arch and including flanges which mate with said seat flanges to form a closed rod receiving channel.

9. An anchor means as set forth in claim 8, wherein said closure member includes a threaded bore substantially perpendicular to the longitudinal axis of said channel and said anchor means further includes at least one set screw received in said bore.

10. An anchor as set forth in claim 9, wherein said set screw includes a rod contacting terminus having a high friction surface.

11. An anchor as set forth in claim 8, wherein said mating flanges include means to inhibit splaying of said first and said second sidewalls.

12. An instrument for use with an anchor member, said anchor member securing an elongated stabilizer relative to a spine, and said anchor member having a channel to receive said stabilizer and a sliding closure means having a sliding cooperation with said seat means whereby said sliding closure means may be slid in the direction of the longitudinal axis of said stabilizer

to engage said seat means, said instrument comprising a handle portion, a shaft portion, and a head portion, said head portion receiving said closure means and having a biased releasable engagement with said closure means.

13. An instrument as set forth in claim 9, wherein said biased releasable engagement is provided by a spring loaded ball plunger.

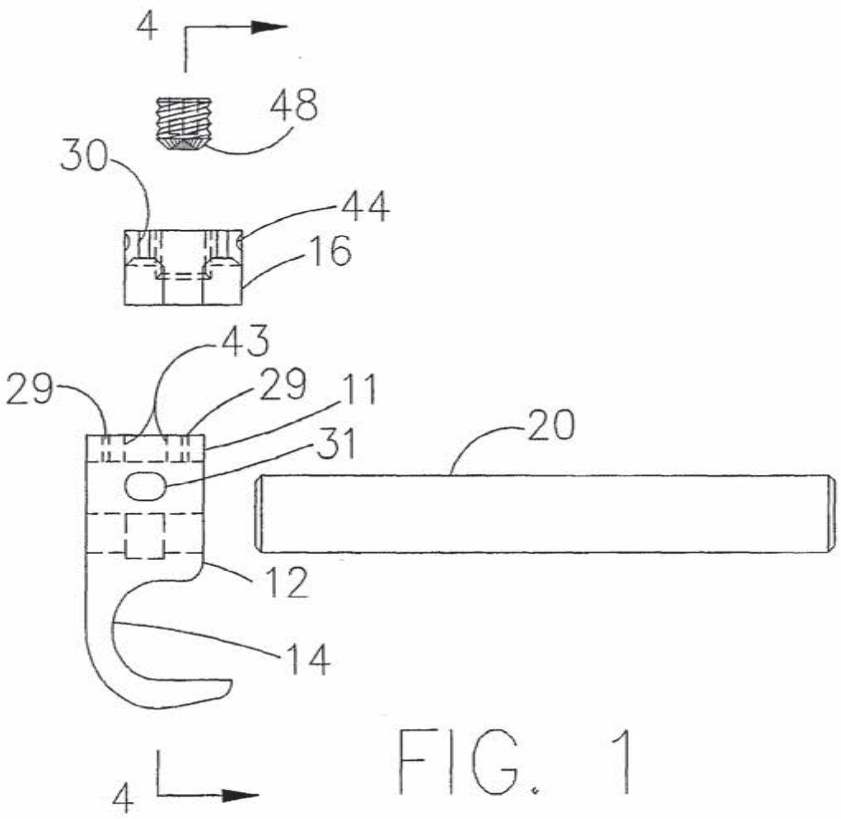


FIG. 1

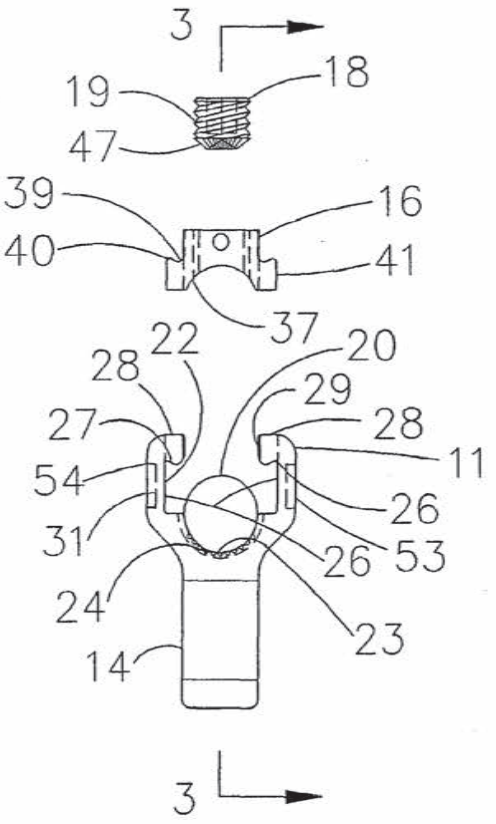


FIG. 2

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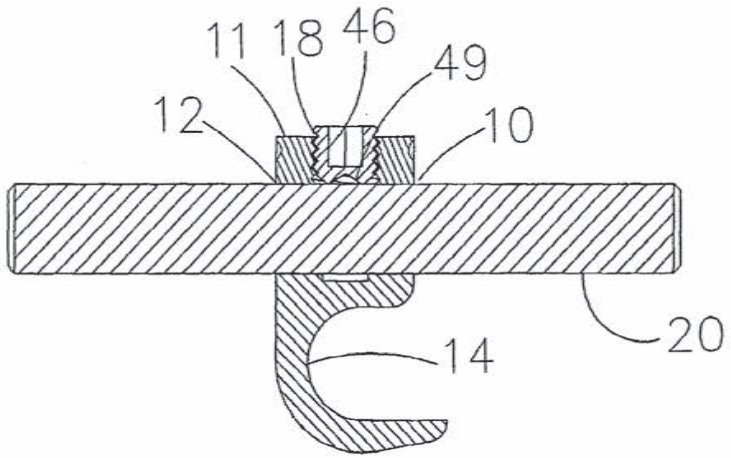


FIG. 3

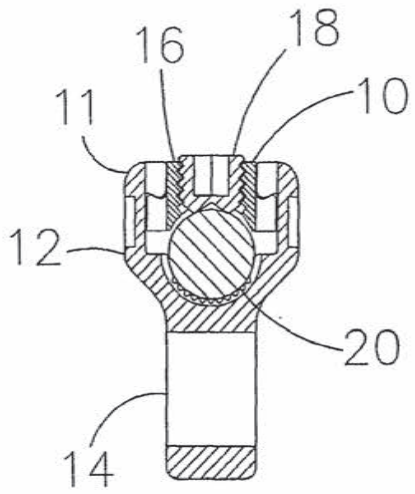


FIG. 4

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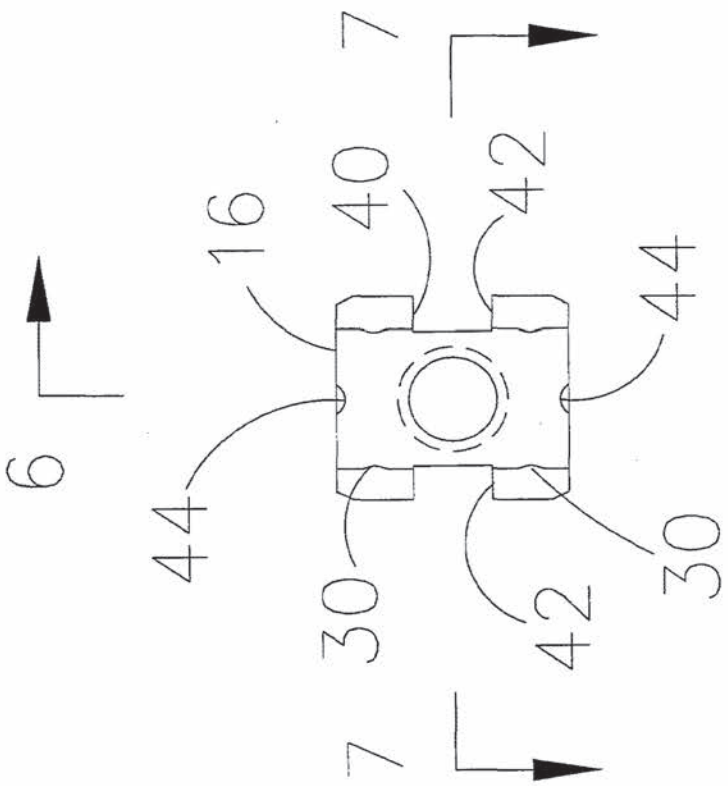


FIG. 5

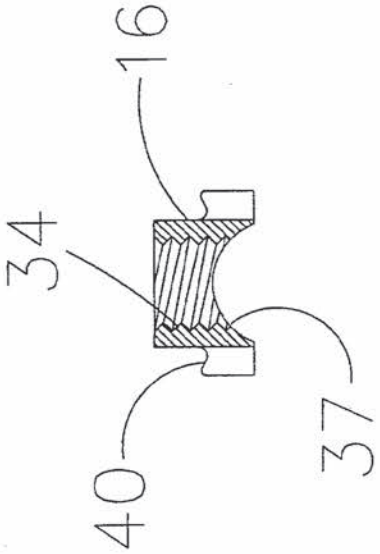


FIG. 7

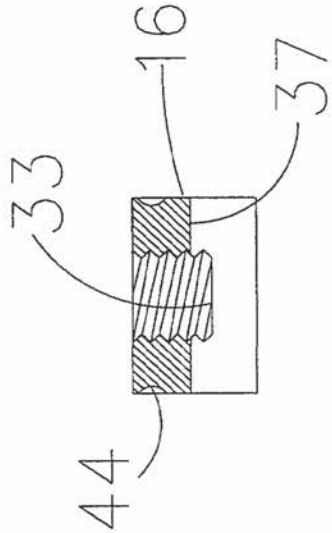


FIG. 6

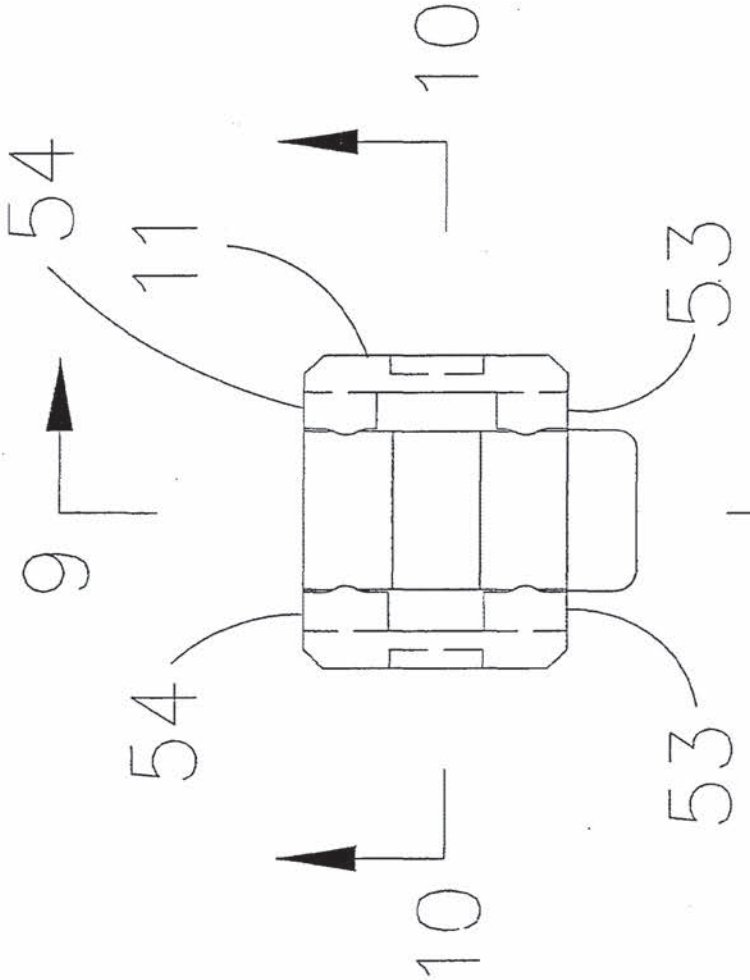


FIG. 8

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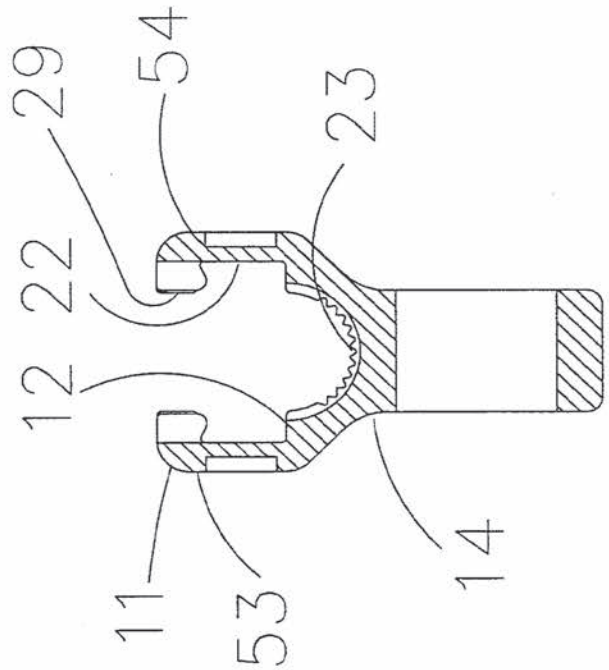


FIG. 10

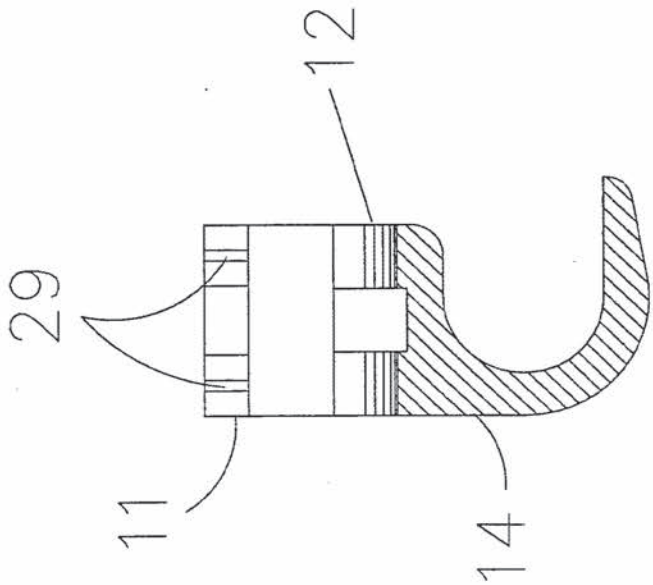


FIG. 9

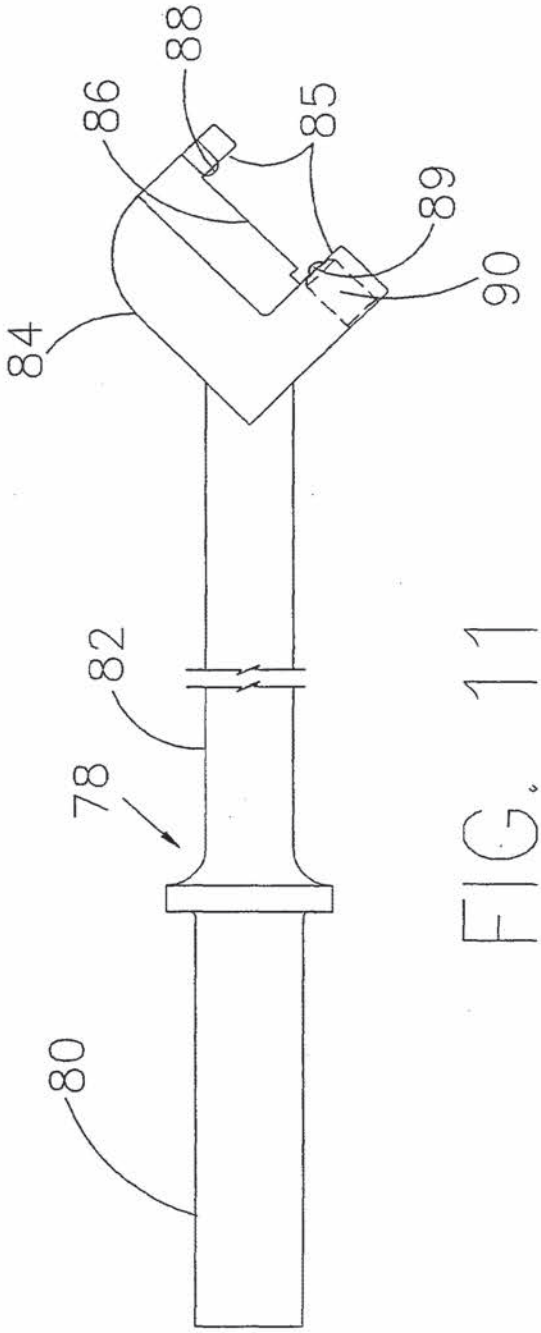


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/13317

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61B 17/70, 17/88
US CL :606/61, 99
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 403/235, 331, 333, 381; 606/59-61, 72, 73, 99

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5,257,993, (ASHER ET AL.), 02 November 1993. See Figs. 20-22.	1-11
X	US, A, 4,347,845, (MAYFIELD), 07 September 1982. See element (24), and Figs. 1-3.	12, 13
X	US, A, 4,887,596, (SHERMAN), 19 December 1989. See whole document	1-11
X	DE, A, 4107480, (ULRICH H), 10 September 1992. See whole document	1-11

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 06 FEBRUARY 1995	Date of mailing of the international search report 10 MAR 1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer TAMARA L. GRAYSAY Telephone No. (703) 308-0858

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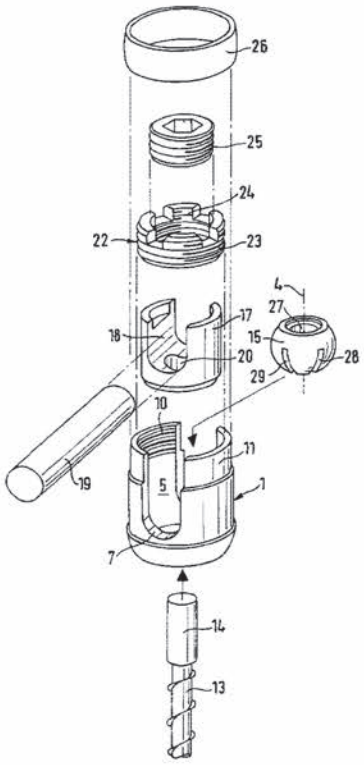
(81) Bestimmungsstaaten *(national)*: JP, KR.

(84) Bestimmungsstaaten *(regional)*: europäisches Patent (AT, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

[Fortsetzung auf der nächsten Seite]

(54) Title: ANCHOR ELEMENT

(54) Bezeichnung: VERANKERUNGSELEMENT



(57) Abstract: An anchor element with a screw (12), comprising a threaded section (13) and a head (15), in the form of a segment of a sphere and a housing piece (1), for connecting the screw (12) to a bar (19) is disclosed. The housing piece (1) comprises a first end (2) and an opposing second end (3), with a longitudinal axis (4) running through both ends (2, 3). The housing piece further comprises a drilling (5) coaxial to the longitudinal axis (4), a first region adjacent to the first end (2), having an essentially U-shaped cross-section (18), with two free sides (8, 9), comprising a thread for housing the bar (19) to be fitted, a region adjacent to the other end (3) for housing the head (15) and an element for exerting pressure on the bar (19) and the head (15). The threaded section (13) and the head (15) are embodied as separate pieces, such that the screw may be used in situations with varying lengths.

(57) Zusammenfassung: Es wird ein Verankerungselement mit einer einen Gewindeabschnitt (13) und einen als kugelsegmentförmigen Abschnitt ausgebildeten Kopf (15) aufweisenden Schraube (12) und einem Aufnahmeteil (1) zum Verbinden der Schraube (12) mit einem Stab (19) geschaffen. Das Aufnahmeteil (1) weist ein erstes Ende (2) und ein diesem gegenüberliegendes zweites Ende (3) und eine durch die beiden Enden (2, 3) gehende Längsachse (4) koaxiale Bohrung (5), einen in einem an das erste Ende (2) angrenzenden ersten Bereich mit einem im wesentlichen U-förmigen Querschnitt (18) mit zwei freien, ein Gewinde aufweisenden Schenkeln (8, 9) zur Aufnahme des einzusetzenden Stabes (19), einen an das andere Ende (3) angrenzenden Bereich zur Aufnahme des Kopfes (15) und ein auf den Stab (19) bzw. den Kopf (15) Druck ausübendes Element auf. Damit die Schrauben vor Ort für verschiedenste Längen verwendbar sind, sind der Gewindeabschnitt (13) und der Kopf (15) als separate Teile ausgebildet.

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Erklärungen gemäß Regel 4.17:

- *hinsichtlich der Berechtigung des Anmelders, ein Patent zu beantragen und zu erhalten (Regel 4.17 Ziffer ii) für die folgenden Bestimmungsstaaten JP, KR, europäisches Patent (AT, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR)*
- *Erfindererklärung (Regel 4.17 Ziffer iv) nur für US*

Veröffentlicht:

- *mit internationalem Recherchenbericht*
- *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eintreffen*

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

Verankerungselement

Die Erfindung betrifft ein Verankerungselement mit einer einen Gewindeabschnitt und einen als kugelsegmentförmigen Abschnitt ausgebildeten Kopf aufweisenden Schraube und einem Aufnahmeteil zum Verbinden der Schraube mit einem Stab nach dem Oberbegriff des Patentanspruches 1. Ein derartiges Verankerungselement wird insbesondere in der Wirbelsäulenchirurgie, aber auch in der Unfallchirurgie bei anderen Knochen eingesetzt.

Ein solches Verankerungselement ist beispielsweise aus der DE 43 07 576 C1 bekannt. Bei derartigen bekannten Verankerungselementen und Schrauben sind der Gewindeabschnitt der Schraube und ihr Kopf einstückig ausgebildet. Da der Chirurg verschiedenste Längen der Schrauben benötigt, muß er immer verschiedene Sätze solcher Schrauben vorrätig haben. Das macht ein erhebliches Vorratslager notwendig mit der Folge erheblicher Kosten.

Aufgabe der Erfindung ist es, diesen Nachteil zu beseitigen.

Diese Aufgabe wird durch das in Patentanspruch 1 gekennzeichnete Verankerungselement gelöst. Dadurch wird es möglich, daß der Chirurg bei der Anwendung den Gewindeabschnitt vor oder nach dem Implantieren auf eine gewünschte Länge kürzt und dann diesen mit dem Kopf und dem Aufnahmeteil verbindet. Auf diese Weise wird die Vorratshaltung wesentlich verkleinert, und gleichzeitig erhöhen sich die Möglichkeiten für den Chirurgen, feinere Justierungen vorzunehmen, da die Schrauben auf jedes Längenmaß kürzbar sind.

Weiterbildungen der Erfindung sind in den Unteransprüchen gekennzeichnet.

Weitere Merkmale und Zweckmäßigkeiten der Erfindung ergeben sich aus der Beschreibung von Ausführungsbeispielen anhand der Figuren.

Von den Figuren zeigen:

Fig. 1 eine Seitenansicht einer ersten Ausführungsform in geschnittener Darstellung;

Fig. 2 die in Fig. 1 gezeigte Ausführungsform in Explosionsdarstellung;

Fig. 3 eine entsprechende Explosionsdarstellung einer zweiten Ausführungsform;

Fig. 4 eine Seitenansicht der ersten in den beiden Ausführungsformen verwendeten Knochenschraube;

Fig. 5 eine Draufsicht auf die Knochenschraube in Fig. 4;

Fig. 6 eine Seitenansicht einer zweiten Ausführungsform der in den ersten beiden Ausführungsbeispielen verwendeten Knochenschraube;

Fig. 7 eine Draufsicht auf die in Fig. 6 gezeigte Knochenschraube;

Fig. 8 eine Seitenansicht einer dritten Ausführungsform einer in den ersten beiden Ausführungsbeispielen gezeigten Knochenschraube;

Fig. 9 eine Seitenansicht einer weiteren Ausführungsform in Schnittdarstellung;

Fig. 10 eine Seitenansicht einer weiteren Ausführungsform in Schnittdarstellung; und

Fig. 11 eine vergrößerte Darstellung des Details X von Fig. 10.

Bei der in den Fig. 1 und 2 gezeigten ersten Ausführungsform weist das Verankerungselement ein zylindrisch ausgebildetes Aufnahmeteil 1 mit einem ersten Ende 2 und einem gegenüberliegenden zweiten Ende 3 auf. Die beiden Enden erstrecken sich senkrecht zu einer Symmetrie- bzw. Längsachse 4. Koaxial zu der Längsachse 4 ist eine von dem ersten Ende 2 aus sich erstreckende erste koaxiale Bohrung 5 vorgesehen, die sich bis zu einem vorbestimmten Abstand von dem zweiten Ende 3 hin erstreckt. An dem zweiten Ende 3 ist eine zweite Bohrung vorgesehen, deren Durchmesser kleiner als der Durchmesser der ersten Bohrung ist. In dem gezeigten Ausführungsbeispiel ist die zweite Bohrung als eine Öffnung ausgebildet, deren Rand

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als hohlkugelsegementförmiger Abschnitt geformt ist, dessen Mittelpunkt zum ersten Ende 2 hin gerichtet ist.

Das Aufnahmeteil 1 weist ausgehend von dem ersten Ende 2 eine sich senkrecht zur Längsachse 3 erstreckende U-förmige Ausnehmung 7 auf mit zwei zum ersten Ende 2 hin endenden freien Schenkeln 8, 9. Angrenzend an das erste Ende 2 weisen die Schenkel ein Innengewinde 10 auf. Der Grund der U-förmigen Ausnehmung erstreckt sich bis zu einem vorgegebenen Abstand von dem zweiten Ende 3 hin. Angrenzend an das erste Ende 2 weisen die Schenkel 8, 9 außen einen Abschnitt 11 auf, dessen Außendurchmesser kleiner ist als der Außendurchmesser des angrenzenden Abschnittes des Aufnahmeteiles.

Die mit dem Aufnahmeteil 1 zusammenwirkende Schraube 12 weist einen als Knochenschraube ausgebildeten Gewindeabschnitt 13 und einen in der in Fig. 1 gezeigten montierten Darstellung damit verbundenen kugelsegmentförmigen Kopf 15 auf. Der Kopf weist einen Radius auf, der so bemessen ist, daß der Kopf bei der in Fig. 1 gezeigten Aufnahme des Kopfes 15 in der zweiten Bohrung 6 zu einem dort gebildeten hohlkugelsegementförmigen Wandabschnitt paßt, wobei der hohlkugelsegmentförmige Abschnitt so ausgebildet ist, daß der Mittelpunkt 16 der Kugel so weit zum ersten Ende 2 hin versetzt ist, daß der Abschnitt ein Widerlager bildet und die Kugel bzw. der Kopf 15 in dem hohlkugelsegmentförmigen Abschnitt der zweiten Bohrung 6 gehalten wird.

Es ist ferner ein Druckelement 17 vorgesehen, welches zylindrisch ausgebildet ist und einen Außendurchmesser aufweist, der gerade so groß ist, daß das Druckelement in die erste Bohrung 5 einführbar und in dieser in Axialrichtung hin- und herbewegbar ist. Auf seiner, dem zweiten Ende 3 zugewandten

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Unterseite weist das Druckelement 17 einen zur Längsachse 4 symmetrisch ausgebildeten hohlkugelsegmentförmigen Abschnitt auf, dessen Radius dem Radius des Kopfes 5 entspricht. Das Druckelement weist eine sich quer zur Längsachse 4 erstreckende U-förmige Ausnehmung 18 auf, deren freie Schenkel sich zum ersten Ende 2 hin erstrecken. Der seitliche Durchmesser dieser U-förmigen Ausnehmung ist so gewählt, daß ein aufzunehmender Stab 19 in die Ausnehmung einsetzbar ist und in dieser seitlich geführt ist. Die Tiefe der hohlkugelsegmentförmigen Ausnehmung ist so gewählt, daß sie in einem Abstand von dem zweiten Ende 3 endet, der größer ist als der dem Radius des Kopfes 15 entsprechenden Abstandes von dem Mittelpunkt 16 zum ersten Ende 2 hin gesehen. Am Grund der U-förmigen Ausnehmung 18 schließt sich eine koaxiale Bohrung 20 an, deren Durchmesser kleiner als der Durchmesser des aufzunehmenden Stabes 19 ist.

Wie aus Fig. 1 ersichtlich ist, weist die U-förmige Ausnehmung 18 an ihrem zum ersten Ende 2 hin gerichteten Ende einen Abschnitt 21 auf, dessen innere Weite größer als der Durchmesser der U-förmigen Ausnehmung 18 ist.

Auf der dem ersten Ende 2 zugewandten Seite schließt sich an das Druckelement 17 eine Mutter 22 an, die ein zu dem Innengewinde 10 passendes Außengewinde 23 und zusätzlich ein Innengewinde 24 aufweist. Die Innenabmessung der Mutter 22 ist so gewählt, daß die innere Weite kleiner als der Durchmesser des Abschnittes 21 ist und größer als der Durchmesser des Stabes 19 und damit der U-förmigen Ausnehmung 18 ist. Ferner ist eine Innenmutter 25 mit einem zum Innengewinde 24 passenden Außengewinde vorgesehen. Schließlich ist eine das freie Ende angrenzend an das erste Ende 2 umfassende Hülse 26 vor-

gesehen, die im zusammengesetzten Zustand auf dem ringförmigen Abschnitt 11 aufsitzt, wie dieser in Fig. 1 gezeigt ist.

Wie am besten aus Fig. 2 zu ersehen ist, weist die Mutter 22 einen Schlitz und die Innenmutter 25 eine Sechskantöffnung zum jeweiligen getrennten Angreifen von Schraubendrehern auf.

Wie am besten aus Fig. 2 zu ersehen ist, ist der Kopf 15 als eine an ihrem dem ersten Ende 2 zuzuwendenden Ende abgeflachte Kugel ausgebildet und weist eine zu der Längsachse 4 koaxiale Bohrung 27 auf. Der Durchmesser der Bohrung 27 ist gleich dem Außendurchmesser des Schaftes 14 und so ausgebildet, daß der Schaft in die Bohrung reibschlüssig einschiebbar ist. Wie aus Fig. 2 ersichtlich ist, ist das so geformte hohlkugelsegmentförmige Element auf seiner dem abgeflachten Ende gegenüberliegenden Seite mit in Umfangsrichtung einen Abstand zueinander aufweisenden und sich parallel zur Längsachse 4 erstreckenden und bis zu dem der abgeflachten Seite gegenüberliegenden Ende reichenden Ausschnitten 28, 29 versehen. Dadurch wird erreicht, daß der dem ersten Ende 2 abgewandte Rand 30 zum Einführen des Schaftes 14 federnd nach außen nachgebbar ausgebildet ist.

Im Betrieb wird zunächst die Schraube 12 in den Knochen bzw. den Wirbel eingeschraubt. Zu diesem Zweck weist der Schaft 14 bekannte Eingriffsmöglichkeiten wie etwa einen Innensechskant auf. Dann kürzt der Operateur den Schaft 14 auf die gewünschte Länge und setzt zunächst das Aufnahmeteil mit der zweiten Bohrung auf den Schaft 14 und führt dann den Kopf von dem ersten Ende 2 her auf den Schaft 14, so daß der Schaft 14 vom federnd nachgebenden Rand 30 her in die Bohrung 27 eingeführt wird und der Kopf den Schaft in der in Fig. 1 gezeigten Weise einschließt. Der Kopf 15 und der Schaft 14 sind reib-

schlüssig miteinander verbunden. Anschließend wird das Druckelement 17 eingesetzt und durch Einschrauben der Mutter 22 so auf den Kopf 15 gedrückt, daß dieser eine gewünschte Drehstabilisierung erfährt. Die Hülse 26 wird aufgebracht und dann wird mit Hilfe der Innenmutter 25 der Stab 19 fixiert. Der Stab 19 übt über das Druckelement 17 einen zusätzlichen Druck auf den Kopf 15 aus.

Durch den vom ersten Ende 2 her gesehen ausgeübten Druck auf den Kopf 15 wird der geschlitzte Kopf 15 einerseits mit dem Schaft 14 bewegungsfest verbunden bzw. verklemmt, gleichzeitig wird der Kopf in seiner Drehstellung arretiert.

Die in Fig. 3 gezeigte zweite Ausführungsform unterscheidet sich von der zuvor beschriebenen Ausführungsform durch einen abgewandelten Kopf 31. Dieser weist wie bei der ersten Ausführungsform in Umfangsrichtung zueinander versetzte Ausschnitte 28 auf, die an dem dem ersten Ende abgewandten Rand 34 frei enden und einen Abstand von dem dem ersten Ende 2 zugewandten Rand 32 aufweisen. Es ist jedoch ein Ausschnitt 33 vorgesehen, der sich vollständig von dem Rand 32 bis zum gegenüberliegenden Rand 34 erstreckt, mit der Folge, daß das so gebildete Kugelsegment um ein durch die Breite des Ausschnittes 33 bestimmtes Ausmaß zusammendrückbar ist. Die Breite des so gebildeten Schlitzes 33 ist so gewählt, daß der Kopf 31 zunächst so weit zusammendrückbar ist, daß er in der in Fig. 3 gezeigten Richtung vom zweiten Ende 2 her in die erste Bohrung 5 hineindrückbar ist und daß dann der Schaft 14 in den Kopf in der gleichen Weise wie oben beschrieben einschiebbar ist und auf die gleiche Weise in verklemmter Position gehalten wird.

Der Schaft 14 der Schraube hat vorzugsweise die in den Fig. 4 und 5 gezeigte zylindrische Form oder auch eine in den Fig. 6 und 7 gezeigte mehreckige Form. In letzterer ist der Querschnitt achteckig ausgebildet. Eine weitere bevorzugte Ausführungsform ist in Fig. 8 gezeigt. Der Schaft ist hier zylindrisch ausgebildet und weist eine rauhe Oberfläche auf, die das Ineingriffbringen zwischen Kugel 15 und Schaft erleichtert.

Die in Fig. 9 gezeigte weitere Ausführungsform stimmt in allen Merkmalen, die das Aufnahmeteil 1, das Druckelement 17, den Stab 19 und die Schrauben 22 und 25 betreffen, mit den vorhergehenden Ausführungsbeispielen überein. Der einzige Unterschied besteht darin, daß der Kopf 15 als ein Kugelsegment ausgebildet ist, welches in seinen äußeren Abmessungen den beiden vorhergehenden Kugelsegmenten entspricht, jedoch keine Ausschnitte 28 oder 33 aufweist. Statt dessen weist das Kugelsegment auf der Innenseite seiner Bohrung 27 ein Innengewinde auf. Anstelle des Schaftes 14 ist ein Schaft 35 mit einem Gewinde vorgesehen, welches zu dem Innengewinde des Kopfes passend ausgebildet ist. Die Bohrung ist als eine Sackbohrung ausgebildet, die an dem dem freien Ende 2 zugewandten Ende endet oder dort einen Anschlag aufweist, so daß die Schraube nur so weit in die gezeigte Stellung einschraubbar ist, in der sie nicht aus dem Kugelsegment an dessen abgeflachter Seite heraussteht. Wie in Fig. 9 gezeigt ist, sind das Innengewinde des Kopfes 15 und das entsprechende Außengewinde des Schaftes 35 in der Richtung vorzugsweise entgegengesetzt zur Richtung des Gewindes des Gewindeabschnittes 13 der Knochenschraube ausgebildet.

Der Betrieb erfolgt in gleicher Weise wie bei dem zuerst beschriebenen Ausführungsbeispiel, wobei nach dem Kürzen des

Schaftes 35 der Kopf 15 vom ersten Ende 2 des Aufnahmeteils 1 her in die Bohrung 5 eingeführt und auf den vom zweiten Ende 3 her eingeführten Schaft 35 aufgeschraubt wird.

Die in den Figuren 10 und 11 gezeigte weitere Auführungsform stimmt in allen Merkmalen, die das Aufnahmeteil 1, das Druckelement 17, den Stab 19 und die Schrauben 22 und 25 betreffen, mit den vorhergehenden Ausführungsbeispielen überein. Anstelle des Schafts 35 und des Kopfes 15 der Ausführungsform nach Fig. 9, welche die zusammenwirkenden Gewinde aufweist, ist bei dieser Ausführungsform der Schaft 37 in einem Abschnitt angrenzend an das dem Knochengewindeabschnitt gegenüberliegenden Ende als Wellenstab ausgebildet. Die Außenfläche des Schaftes weist in Umfangsrichtung verlaufende Wellentäler 38 und dazwischenliegende Wellenkämme 39 auf. Die Wellentäler 38 haben in Umfangsrichtung gesehen einen kreisabschnittförmigen Querschnitt und ihr Durchmesser auf halber Höhe bzw. Tiefe ist deutlich größer als der entsprechende Durchmesser des Wellenbergs 39, so dass die Wellenberge 39 spitz sind im Verhältnis zu dem Grund der Wellentäler 38. Der Kopf 15 ist als ein Kugelsegment ausgebildet, welches in seinen äußeren Abmessungen den zuvor genannten Kugelsegmenten entspricht, das jedoch keine Ausschnitte 28 oder 33 aufweist. Auf der Innenseite seiner Bohrung 27 weist das Kugelsegment des Kopfes 15 in Umfangsrichtung verlaufende Wellen mit Wellentälern 40 und Wellenkämmen 41 auf, die jeweils den Wellenkämmen 39 bzw. den Wellentälern 38 des Schaftes 37 entsprechen. Zwischen den Wellentälern 38 und den Wellenkämmen 39 des Schaftes einerseits und den entsprechenden Wellenkämmen 40 und Wellentälern 41 andererseits ist ein kleiner Zwischenraum, so daß der Schaft in das Kugelsegment einführbar ist.

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Der Betrieb erfolgt in ähnlicher Weise wie bei dem Ausführungsbeispiel gemäß Fig. 9. Das Kürzen des gewellten Schaftes 37 ist jedoch bei dieser Ausführungsform einfacher als das Kürzen des Schaftes 35 mit dem Gewinde gemäß Fig. 9, da die Wellentäler 38 ein leichtes Abschneiden ermöglichen, während bei dem Schaft 35 mit dem Gewinde gemäß Fig. 9 darauf geachtet werden muß, daß das Gewinde nicht zerstört wird. Nach dem Kürzen des Schaftes 37 wird der Kopf 15 von dem ersten Ende 2 des Aufnahmeteils 1 in die Bohrung 5 eingeführt und auf den Schaft 37 aufgedrückt. Dabei wirken die Wellen des Schaftes 37 und die entsprechenden der Bohrung 27 des Kopfes 15 zusammen, so daß der Schaft gehalten wird.

In den oben beschriebenen Ausführungsbeispielen wird der Kopf 15 jeweils durch einen mit dem Aufnahmeteil 1 einstückig ausgebildeten Rand gehalten. Ein solches Widerlager kann auch auf andere Weise gebildet werden, beispielsweise ist es möglich, die erste Bohrung 5 vollständig durch das Aufnahmeteil 1 hindurch zu bohren und dann angrenzend an das zweite Ende ein den Kopf 15 aufnehmendes Halteelement einzuspannen.

In den oben beschriebenen Ausführungsbeispielen weist das Aufnahmeteil stets die Mutter 22 und eine Innenmutter 25 sowie eine Hülse 26 auf. Diese Fixierung kann in bekannter Weise auch anders ausgebildet sein. Insbesondere kann gegebenenfalls auch lediglich eine Innenmutter vorgesehen sein.

Bei dem oben unter Bezugnahme auf Fig. 9 beschriebenen Ausführungsbeispiel weist der Kopf 15 keine Ausschnitte 28, 33 auf. In einer weiteren Ausführungsform weisen Kopf 15 und Schaft 35 wie bei der in Fig. 9 gezeigten Darstellung zueinander passende Gewinde auf. Der Kopf 15 weist jedoch zusätz-

lich den sich über die gesamte Länge erstreckenden Ausschnitt 33, so daß wie bei der in Fig. 3 gezeigten Ausführungsform der Kopf ohne eingeschraubten Schaft von dem Rand 3 aus durch Zusammendrücken in das Aufnahmeteil einschiebbar ist und dann auf den ebenfalls vom Ende 3 her einführbaren Schaft 35 durch Einschrauben aufnimmt und mit diesem verbunden wird. Der Schlitz führt beim Aufsetzen der Druckelemente bzw. beim Ausüben des Druckes auf den Kopf 15 dazu, daß gleichzeitig der Kopf und der Schaft 35 fester zusammengedrückt werden als ohne einen solchen Schlitz.

In einer weiteren Ausführungsform können zusätzlich noch Ausschnitte 28 in der in Fig. 3 gezeigten Weise vorgesehen sein, um so ein noch stärkeres Anpressen an den Gewindeschaft 35 zu bewirken.

Patentansprüche

1. Verankerungselement mit einer einen Gewindeabschnitt (13) und einen als kugelsegmentförmiger Abschnitt ausgebildeten Kopf (15) aufweisenden Schraube (12) und einem Aufnahmeteil (1) zum Verbinden der Schraube (12) mit einem Stab (19), wobei das Aufnahmeteil (1)
ein erstes Ende (2) und ein diesem gegenüberliegendes zweites Ende (3), eine durch die beiden Enden (2, 3) gehende Längsachse (4),
eine zur Längsachse (4) koaxiale Bohrung (5), einen in einem an das erste Ende (2) angrenzenden ersten Bereich mit einem im wesentlichen U-förmigen Querschnitt (7) mit zwei freien ein Gewinde aufweisenden Schenkeln (8, 9) zur Aufnahme des einzusetzenden Stabes (19), einen an das andere Ende (3) angrenzenden Bereich zur Aufnahme des Kopfes (15) und
ein auf den Stab (19) bzw. auf den Kopf (15) Druck ausübendes Element (22, 17) aufweist,
dadurch gekennzeichnet, daß
der Gewindeabschnitt (13) und der Kopf (15) als separate Teile ausgebildet sind.

2. Verankerungselement nach Anspruch 1, dadurch gekennzeichnet, daß der Gewindeabschnitt (13) an dem kopfseitigen Ende einen Schaft (14) aufweist.

3. Verankerungselement nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Kopf (15) auf seiner dem Gewindeabschnitt (13) zugewandten Seite einen federnd nachgebenden Rand aufweist.

4. Verankerungselement nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß der dem Gewindeabschnitt zugewandte Rand (34) eine oder mehrere zur Symmetrieachse (4) parallel gerichtete und umfangsmäßig verteilte Durchbrechungen bzw. Ausnehmungen (28, 29, 33) aufweist.

5. Verankerungselement nach Anspruch 4, dadurch gekennzeichnet, daß eine Durchbrechung (33) sich in Richtung parallel zur Symmetrieachse (4) gesehen über die gesamte Wandlänge erstreckt.

6. Verankerungselement nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß der Kopf (15) eine zur Symmetrieachse koaxiale Bohrung (27) aufweist.

7. Verankerungselement nach Anspruch 6, dadurch gekennzeichnet, daß die Bohrung (27) zylindrisch ausgebildet ist.

8. Verankerungselement nach einem der Ansprüche 2 bis 7, dadurch gekennzeichnet, daß der Schaft (14) eine rauhe Oberfläche aufweist.

9. Verankerungselement nach einem der Ansprüche 2 bis 8, dadurch gekennzeichnet, daß der Schaft (14) mehreckig ausgebildet ist.

10. Verankerungselement nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß der Kopf (15) in der Bohrung ein Innengewinde und der Schaft (35) ein dazu passendes Außengewinde aufweist.

11. Verankerungselement nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß der Kopf (15) in der Bohrung in Umfangsrichtung gewellt ausgebildet ist und der Schaft (37) an seiner Außenseite eine entsprechende Wellung aufweist.

FIG.2

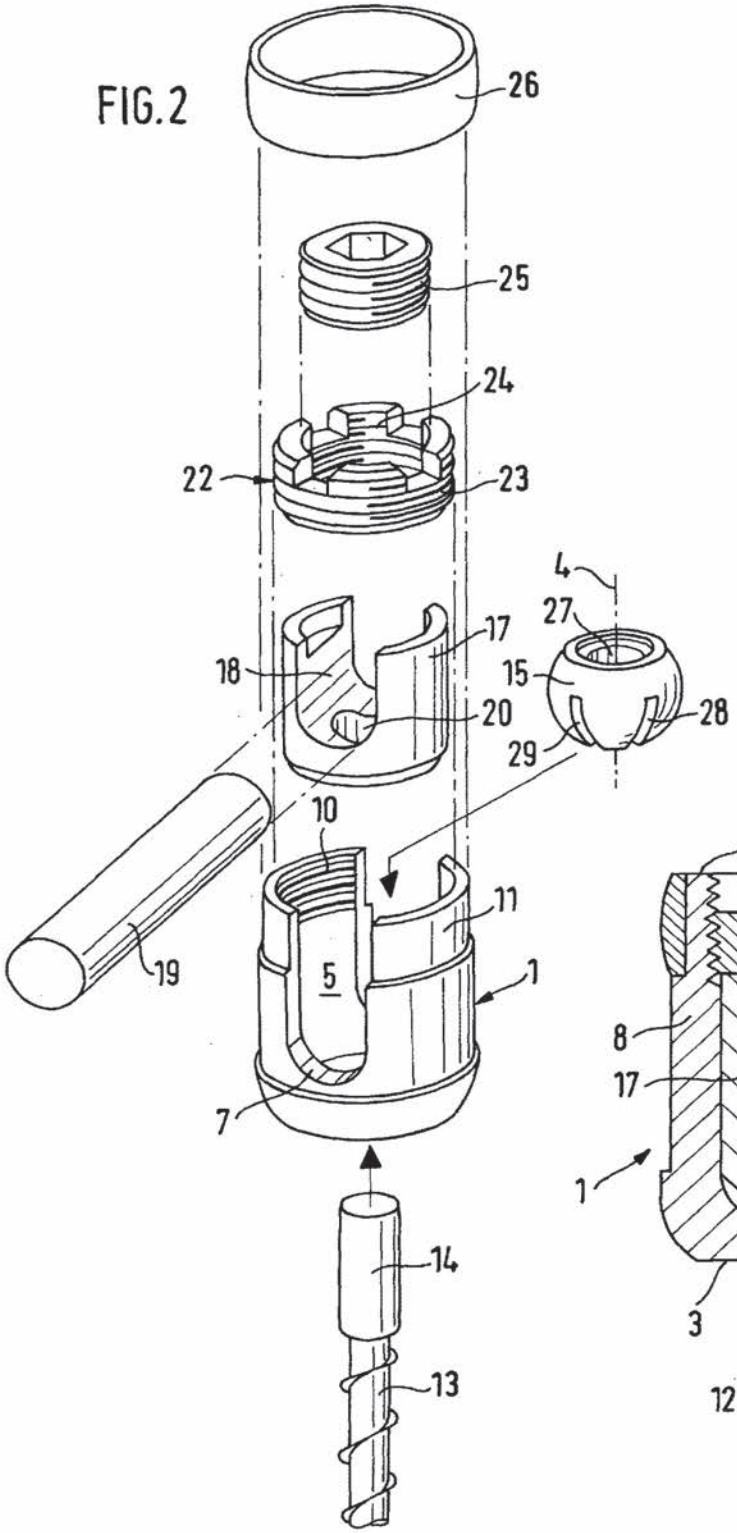
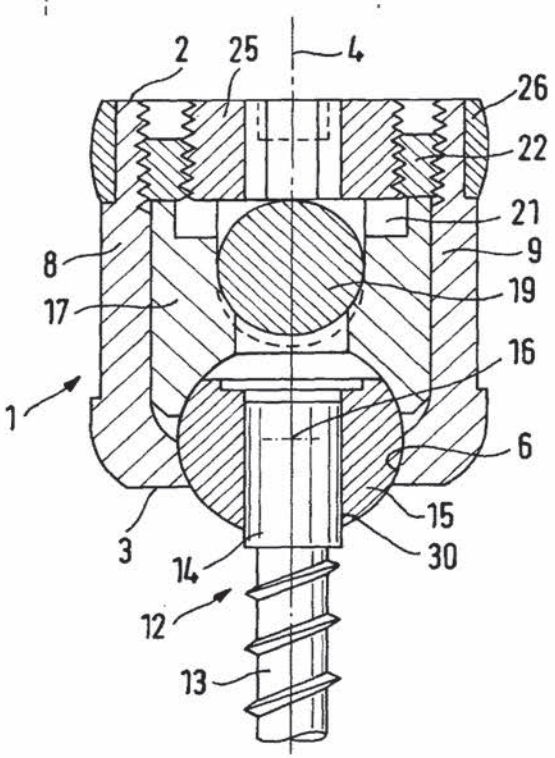


FIG.1



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FIG.3

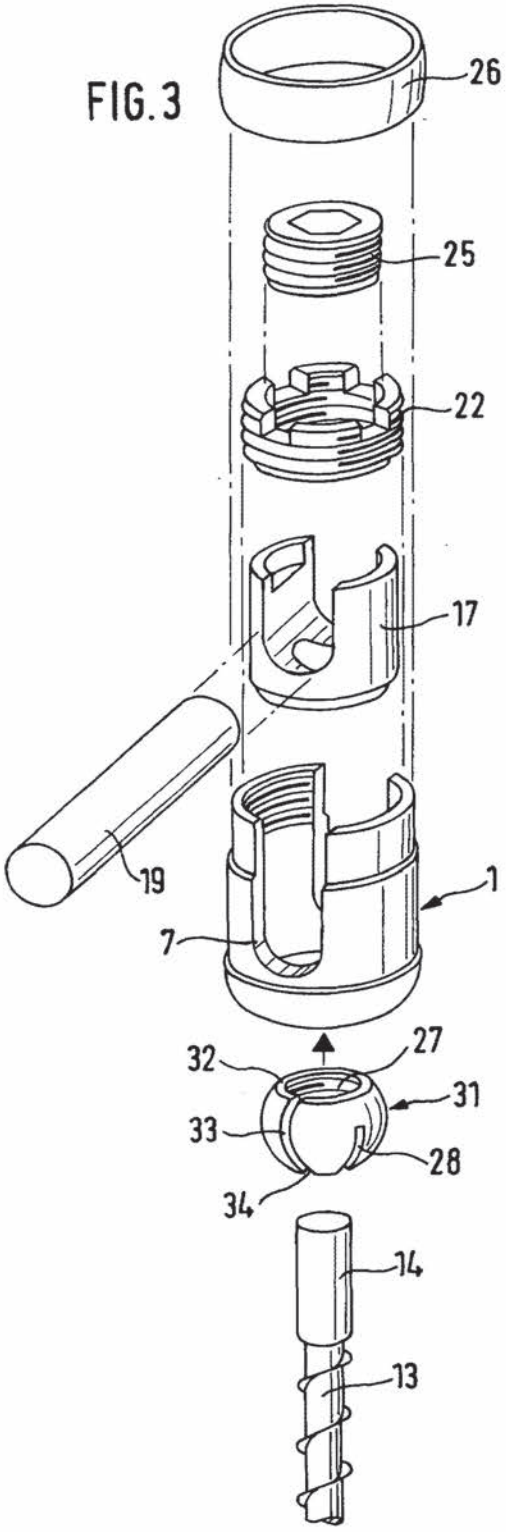
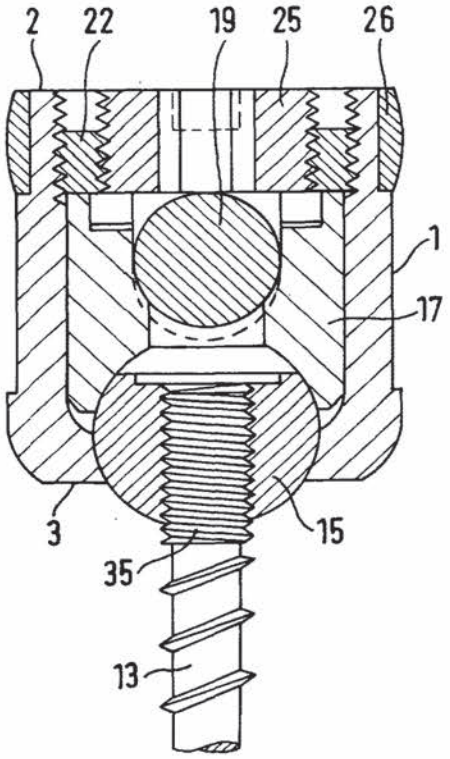


FIG.9



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FIG.4

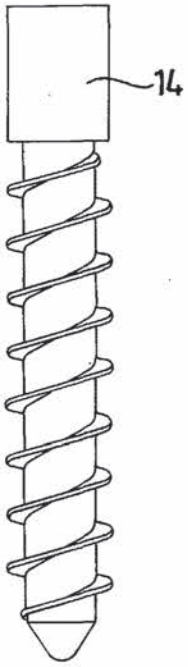


FIG.5

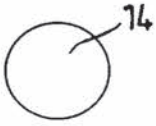


FIG.6

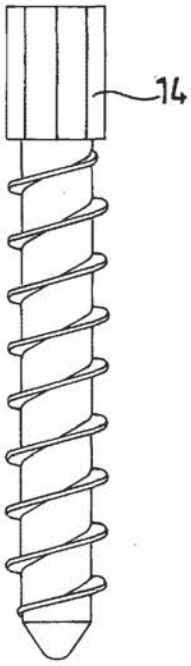


FIG.7

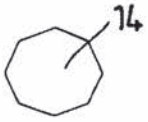
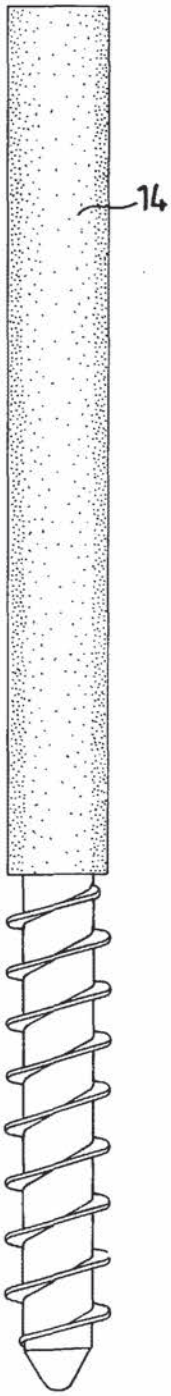


FIG.8



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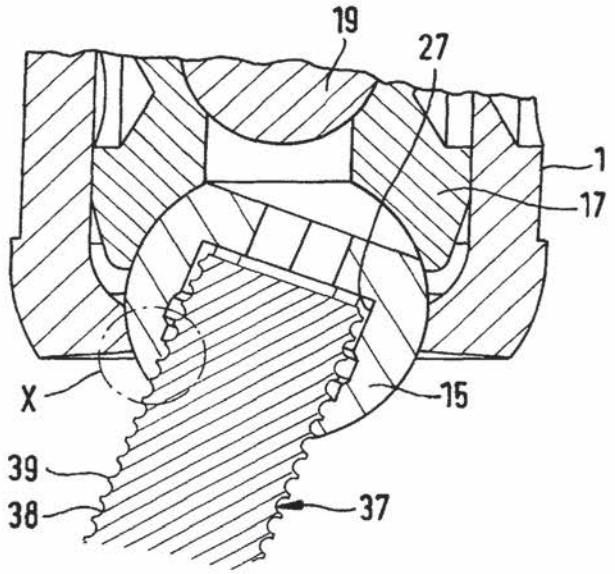


FIG.10

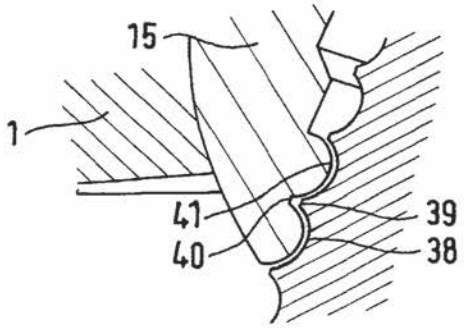


FIG.11

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/01284

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B17/70 A61B17/86

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01 03593 A (FERUS ROBERT ;FRIGG ROBERT (CH); SYNTHES AG (CH); SYNTHES USA (US)) 18 January 2001 (2001-01-18) abstract; claim 1; figure 6 ---	1,10,11
X	EP 0 933 065 A (SULZER ORTHOPAEDIE AG) 4 August 1999 (1999-08-04)	1
A	the whole document ---	2-11
A	WO 94 00066 A (HESS MARTIN ;SYNTHES AG (CH); SCHLAEPFER JOHANNES FRIDOLIN (CH)) 6 January 1994 (1994-01-06) abstract; figures 1,2 ---	1-11
A	FR 2 786 088 A (DIMSO SA) 26 May 2000 (2000-05-26) abstract; figure 3 ---	1,3-7
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19 July 2002	29/07/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Hansen, S

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

formation on patent family members

International Application No
PCT/EP 02/01284

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Form PCT/ISA/210 (patent family annex) (July 1992)

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP 02/01284

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IPK 7 A61B17/70 A61B17/86

Nach der Internationalen Patentklassifikation (IPK) oder nach der nationalen Klassifikation und der IPK

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
IPK 7 A61B

Recherchierte aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie°	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	WO 01 03593 A (FERUS ROBERT ;FRIGG ROBERT (CH); SYNTHES AG (CH); SYNTHES USA (US)) 18. Januar 2001 (2001-01-18) Zusammenfassung; Anspruch 1; Abbildung 6 ---	1,10,11
X	EP 0 933 065 A (SULZER ORTHOPAEDIE AG) 4. August 1999 (1999-08-04)	1
A	das ganze Dokument ---	2-11
A	WO 94 00066 A (HESS MARTIN ;SYNTHES AG (CH); SCHLAEPFER JOHANNES FRIDOLIN (CH)) 6. Januar 1994 (1994-01-06) Zusammenfassung; Abbildungen 1,2 ---	1-11
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[X] Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen

[X] Siehe Anhang Patentfamilie

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Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
19. Juli 2002	29/07/2002

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Hansen, S

Formblatt PCT/ISA/210 (Blatt 2) (Juli 1992)

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP 02/01284

C.(Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

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Formblatt PCT/ISA/210 (Fortsetzung von Blatt 2) (Juli 1992)

INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentli[illegible]n, die zur selben Patentfamilie gehören

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Kassel, the 16th May 2002 hz / st lawyer's file 19405

[0002]
Applicant: File N. N.

[0003]

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Anchoring element for fastening a rod of a

[0007]
Device for setting up a human or animal spine on a vertebral bone

[0008]
The present invention relates to an anchoring element for fixing a rod of a device for establishing a human or animal spine on a vertebral bone, comprising a substantially U-shaped and two substantially parallel holding webs comprehensive holder, in which a receiving slot for receiving the rod is, and with a counter to the received in the receiving slot rod securing element.

[0009]

f?

X K i "

[0010]

From DE 94 02 839 a pedicle screw is known, which is anchored with its threaded shaft in a vertebral body and having at its protruding from the vertebral bone end of a U-shaped holder with two parallel aligned holding webs.

In this case, a receiving slot for receiving a distraction or compression rod is formed between the

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retaining webs, which can be secured and fixed by means of a fastened to the free ends of the retaining webs securing element.

This securing element is composed in a first embodiment of a hexagonal, annular element with a locking screw inserted therein, wherein the entire securing element can be inserted into a corresponding groove in the retaining webs. The securing element spans the receiving slot, so that the locking screw acts directly on the rod to fix it.

[0011]
In another embodiment, the securing element consists of a sleeve enclosing the retaining element with internal thread, wherein the shell can be screwed onto a corresponding, provided on the outer sides of the retaining webs thread, so that provided on the end face of the shell locking screw can engage in the receiving slot to fix the rod.

[0012]

In such a device, therefore, the pedicle screw must first be anchored in the vertebral body, in order to then insert the rod in the receiving slot.

Thereafter, the securing element is either inserted into the grooves or screwed onto the holder before the vortex or the rod is brought by tightening the locking screw in the desired position. This has proven to be very difficult in practice, since either the insertion of the fuse element into the grooves or the screwing of the fuse element on the holder requires a lot of tact, while at the same time must be taken to ensure that

[0013]
Vertebral body and / or the rod meanwhile does not slip.

[0014]

From DE 297 10 484 an anchoring element is known in which a sawtooth thread for receiving the locking screw is provided on the inner sides of the holding webs.

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This ensures that the forces acting radially on the retaining webs in a normal thread accounts and attack only axially acting forces on the retaining web. As a result, a bending apart of the holding webs is prevented, so that even the holding webs comprehensive ring element can be omitted. Again, it has proven in practice to be very tedious to screw the respective locking screw in the corresponding sawtooth while keeping the spine and / or the rod as long in the desired position until the locking screw holds the rod independently.

[0015]
Based on this, the present invention seeks to provide an anchoring element, wherein the securing element reliably absorbs the forces occurring and in which the securing element is easy and quick to install.

[0016]
As a technical solution to this problem is proposed according to the invention, the above-mentioned anchoring element in that the securing element comprises a locking element and a ring member, wherein the ring member is attachable by means of a Renkverbindung at the free end of the holding webs.

[0017]

A trained according to this technical teaching anchoring element has the advantage that the ring element only needs to be placed axially on the free end of the holding webs and can be brought by a slight pivoting in its final, secured position.

Such a secured ring element holds in the receiving slot

[0018]
already located provisionally in the desired position, so that the operating doctor can now screw in the locking element in order to adjust the rod and fix.

[0019]

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It has proven to be advantageous to form the Renkverbindung as a bayonet lock, with a radially projecting gripper and a slot or groove-like recording, wherein the gripper engages in the receptacle to fix the ring member of the holding webs.

Such a bayonet closure is inexpensive to implement and allows a quick and easy attachment of the ring member to the holder of the anchoring element.

[0020]
The configuration of the receptacle with an axial introduction and a radial holding element has the advantage that the gripper can be brought into the introduction in a simple manner and passes by rotation in the holding element to remain there and form a positive bayonet closure.

[0021]
It is understood that the rod may be formed, for example, as a distraction, compression or connecting rod.

[0022]

In a preferred embodiment, the ring element is insertable into the receiving slot and attachable between the retaining webs, wherein the gripper is mounted externally on the ring member, while the receptacle is arranged in the retaining webs.

This has the advantage that hereby the ring element is also integrated in the receiving slot, so that the entire anchoring element can be made very small.

[0023]

In another preferred embodiment, the ring element surrounds the retaining webs, wherein the receptacle is arranged in the ring element, while the gripper is attached to the retaining webs.

This has the

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[0024]
Advantage that also by this the radial forces emanating from the locking element are absorbed by the ring member, without causing the holding webs are pressed in an undesirable manner.

[0025]

In yet another preferred embodiment, the insertion is V-shaped.

This has the advantage that the introduced into this introduction gripper need only be placed roughly on the introduction and then properly performed by the V-shaped configuration to the transversely oriented support member to be subsequently introduced by pivoting the ring member in this.

As a result, the placement of the ring element on the retaining webs is further simplified.

[0026]

In a further preferred embodiment, the Halteelemet is formed rising upward, whereby the ring member must perform not only a rotating, but in addition an axial movement in order to be solved. By such a Zusatzerfordenis when loosening the ring element unintentional release of the ring element is difficult. Anloges applies to a broadening of the end of the retaining element.

[0027]

In yet another preferred embodiment of the gripper is designed as a pin edge. The flank advantageously rests against the holding element with a larger area, so that unintentional detachment of the ring element is tempered by the correspondingly higher friction.

[0028]
In yet another preferred embodiment, the gripper extends through and out of the receptacle and is curved or inclined, preferably in the direction of the forces on the securing element, such that the

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retaining strut faces inwards

[0029]

is pressed.

Hierdruch the holding webs are pressed inward due to the effective holding forces of the anchoring elements and it is ensured that the ring member is reliably held in the retaining webs. A jumping out of the fuse element due to bending retaining webs is prevented.

[0030]

In a preferred embodiment, a thread for receiving the locking element is provided in the ring element. In addition to the above-mentioned advantage that thereby a small size is achieved, this also has the advantage that the radial forces emanating from the locking element are completely absorbed by the ring element, without deformations occur as in the prior art.

[0031]

Further advantages of the anchoring element according to the invention will become apparent from the accompanying drawings and the embodiments described below. Likewise, according to the invention, the features mentioned above and those which are still further can be used individually or in any desired combinations with one another. The mentioned embodiments are not to be understood as exhaustive enumeration, but rather have exemplary character. Show it:

[0032]
Fig. 1 is an exploded view of a first Ausführngsform an anchoring element according to the invention with a rod;

[0033]
FIG. 2 shows a plan view of the ring element according to FIG. 1; FIG. 3 shows a partially sectioned side view of the anchoring element according to FIG. 1, cut along line IM-IM in FIG. 1;

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[0034]
4 shows an exploded view of a second embodiment of an anchoring element according to the invention with a rod;

[0035]
Fig. 5 is a plan view of the ring member of FIG. 4; Fig. 6 is a side view of the anchoring element of FIG. 4; 7 is an exploded view of a third embodiment of a

[0036]
anchoring element according to the invention with a rod;

[0037]
FIG. 8 shows a plan view of the ring element according to FIG. 7; FIG.

[0038]
9 shows a partially sectioned side view of the anchoring element according to FIG. 7, cut along line IX - IX in FIG. 7; 10 is an exploded view of a fourth embodiment of an anchoring element according to the invention with a rod;

[0039]
11 shows a plan view of the ring element according to FIG. 10; FIG. 12 shows a side view of the anchoring element according to FIG. 10; FIG. 13 is an exploded view of a fifth embodiment of an anchoring element according to the invention with a rod; FIG. 14 shows a plan view of the ring element according to FIG. 13; FIG. FIG. 15 shows a side view of the anchoring element according to FIG. 13; FIG. 16 shows an exploded view of a sixth embodiment of an anchoring element according to the invention with a rod; 17 shows a plan view of the ring element according to FIG. 16;

[0040]
FIG. 18 is a partially sectioned side view of the anchoring element according to FIG. 16, cut along line XVIII-XVIII in FIG. 16; FIG.

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[0041]

19 is an exploded view of a seventh embodiment of an anchoring element according to the invention; FIG. 20 shows a plan view of the ring element according to FIG. 19; FIG. Fig. 21 is a side view of the anchoring element according to Flg.

19.

[0042]

FIGS. 1 to 3 show a first embodiment of an anchoring element embodied as a pedicle screw, wherein the anchoring element for insertion into the vertebral bone has a threaded shaft 10 and a U-shaped holder 12 with two retaining struts 14, 16, substantially parallel, a ring element 18 and designed as a grub screw locking element 20 includes.

In this case, a receiving slot 22 for receiving a rod 24 is provided in the holder 12, which over which from the locking element

[0043]
and the ring member 18 composed fuse element is fixed.

[0044]

In this embodiment, two bayonet pins 26, 28 are radially projecting on the ring member 18 on opposite sides, which in a entssprechende, formed on the inside of the holding webs 14, 16 insertion 30 and a holding member 32 are used.

In this case, the ring member 18 is inserted with its two pins 26, 28 from above into the upwardly open insertion 30, and brought to the bottom of the introduction 30 before the ring member 18 is pivoted by a few degrees, so that the pins 26, 28th be performed to the end of the holding element 32.

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Arrived in this position, the ring member 18 is released and remains reliably in this position.

[0045]
As can be clearly seen in FIG. 3, the insertion 30 is V-shaped to form a large catching area for insertion of the pins 26, 28.

[0046]

In the ring member 18, an internal thread 34 is provided for receiving the locking screw 20 formed as a locking element.

In this case, the locking member 20 is screwed in so far into the ring member 18 that the locking member 20 presses on the rod 24 and fixes it in the desired position.

[0047]

FIGS. 4 to 6 show a second embodiment of an anchoring element according to the invention, also embodied as a pedicle screw.

Again, the anchoring element is composed of a threaded shaft 40 for attachment of the anchoring element in the vertebral bone, a U-shaped bracket 42 with two substantially parallel retaining webs 44, 46, a ring member 48 and a lock screw designed as a Madame 50th

[0048]

together.

In this embodiment, on the respective inner sides of the holding webs 44, 46, an internal thread 52 is formed for receiving the locking element designed as a set screws 50.

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In order that in this embodiment the radial forces acting on the holding webs 44, 46 do not lead to a bending of the holding webs 44, 46, in this case the ring element 48 is placed around the holding webs 44, 46 on the outside.

[0049]
Also in this embodiment, a receiving slot 54 of a rod 24 is formed in the holder 42, which is determined by the locking element 50 in the desired position.

[0050]

On the outwardly facing sides of the holding webs 44, 46 each have a radially projecting pin 56, 58 is provided, which are inserted into corresponding, provided on the inside ring element 48 leads 61, which also here at the introduction 60, 61 correspondingly perpendicular corresponding holding elements 62, 63 connect.

Again, the introducers 60, 61 are V-shaped to realize a large catch area.

[0051]

FIGS. 7 to 9 show a third embodiment of an anchoring element according to the invention, also designed as a pedicle screw.

This third embodiment differs from the first embodiment according to FIGS. 1 to 3 in that on the inside of the holding webs 14, 16, then a slightly upwardly rising support member 66 is formed on the introduction 30, at the end of a widening 68 is provided is.

The broadening 68 is designed substantially circular.

In this holding element 66 of the pin 26, 28 can be inserted and clamped at a corresponding rotation of the ring member 18 in the upwardly extending support member 66, so that in this way a clamping protection is achieved. In this case, the holding element 66 increases in the direction of

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the forces acting on the securing element.

[0052]

The broadening 68 at the end of the holding element 66 also causes that during rotation of the ring member 18 between pin 26, 28, and Ring member 18 on the one hand and the holding webs 14, 16 on the other hand built-up voltage is at least partially degraded again, since the widening 68 extends partially in the direction of the holding force and thus partially abolishes the pressure between the fuse element and rod 24. At the same time thereby a reliable and permanent securing of the ring member 18 is achieved, since to release the ring member 18 just this pressure must be rebuilt, which is not possible without external, targeted force. This means that the ring member 18 can not solve by itself.

[0053]

FIGS. 10 to 12 show a fourth embodiment of an anchoring element according to the invention, also embodied as a pedicle screw. This fourth embodiment differs from the second embodiment according to FIGS. 4 to 6 in that on the inside of the ring element 48, a slightly upwardly rising holding element 70 is then formed on the introduction 61. In this holding element 70, the pin 56, 58 can be inserted and clamped at a corresponding rotation of the ring member 48 in the upwardly extending support member 70, so that in this way a clamping protection is achieved.

[0054]
In an embodiment not shown here, the end of the holding element 70, analogous to the holding element 66 of FIG. 9, widened.

[0055]

A fifth embodiment of an anchoring element according to the invention, also designed as a pedicle screw, is shown in FIGS. 13 to 15.

This fifth embodiment differs from the second embodiment according to FIGS. 4 to 6 in that here the gripper

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[0056]
· & Idigr;

[0057]

As a bayonet edge 72, 74 is formed, which is insertable into a corresponding insertion 76, 77 and retaining element 78 on the ring member 48.

By the broad edge 72, 74 creates a large contact surface between the ring member 48 and retaining web 44, 46, which leads to a large friction as soon as the ring member 48 is placed properly. This friction, in turn, hinders the unintentional release of the ring element 48, so that in this way a safeguard against unintentional release of the ring element 48 is achieved.

[0058]

FIGS. 16 to 18 show a sixth embodiment of an anchoring element according to the invention, also designed as a pedicle screw. This sixth embodiment differs from the first embodiment according to FIGS. 1 to 3 in that here too the pins have been replaced by flanks 80, 82, which engage in a corresponding insertion 84 and retaining element 86. Otherwise the same applies to the fifth embodiment.

[0059]

The illustrated in FIGS. 19 to 21 seventh embodiment of an anchoring element according to the invention substantially corresponds to the first embodiment shown in FIGS. 1 to 3, only the gripper of the bayonet closure is formed differently here. As can be seen from FIG. 19, the gripper of the bayonet closure is designed as a radially projecting, upwardly inclined pin 90, 92. This pin 90, 92 is longer than the comparable pin 26, 28 in FIG. 1.

[0060]

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After the rod 24 has been inserted into the receiving slot 22, the ring member 18 is also inserted into the receiving slot 22 in the axial direction. The pins 90, 92 are aligned so that they reach the introduction 30. Now, the operating surgeon must press the ring member 18 with appropriate force on the rod 24, so that the latter is pushed deeper into the receiving slot 22, and so

[0061]

that the pins 90, 92 reach the bottom of the introduction 30. Arrived in this position, the ring member 18 can be pivoted by an angular width, so that the pins 90, 92 reach the holding member 32. Since the rod 24 is biased in this case, the latter presses permanently on the ring member 18th That is, as shown in FIGS. 19 to 21, the ring member 18 is pushed upward. The pins 90, 92 are now made so long that they protrude from the support member 32 and are also inclined according to the force acting on the ring member 18 force upwards. Due to this inclination of the pins 90, 92, the forces acting on the pins 90, 92 by the rod 24 are decomposed into an axial and a radial component. The radial component causes the retaining webs 14, 16 are pressed inwards. This ensures that the ring member 18 is reliably fixed in the holding webs 14, 16 even with large, occurring forces.

[0062]
In another embodiment, not shown here, the pins are curved, also to push the holding webs inwards.

[0063]
It goes without saying that the flank 80, 82 according to FIGS. 60 to 80 can also be inclined or curved.

[0064]
The rod 24 may be formed, for example, as a connection, distraction or compression rod depending on the purpose.

[0065]
LIST OF REFERENCE NUMBERS

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[0066]
10 threaded shaft

[0067]
12 holder

[0068]
14 holding web

[0069]
16 holding web

[0070]
18 ring element

[0071]
20 Fixing element

[0072]
22 receiving slot

[0073]
24 Rod

[0074]
26 pen

[0075]
28 pen

[0076]

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30 introduction

[0077]
32 retaining element

[0078]
34 inner thread

[0079]
40 threaded shaft

[0080]
42 holder

[0081]
44 holding web

[0082]
46 holding web

[0083]
48 rings element

[0084]
50 Fixing element

[0085]
52 inner thread

[0086]
54 receiving slot

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[0087]
56 pen

[0088]
58 pen

[0089]
61 introduction

[0090]
62 retaining element

[0091]
63 Holding element 66 holding element 68 widening 70 holding element 72 flank

[0092]
74 flank

[0093]
76 introduction

[0094]
77 introduction

[0095]
78 Retaining element 80 flank

[0096]
82 flank

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[0097]
84 introduction

[0098]
86 retaining element

[0099]
90 pen

[0100]
92 pen

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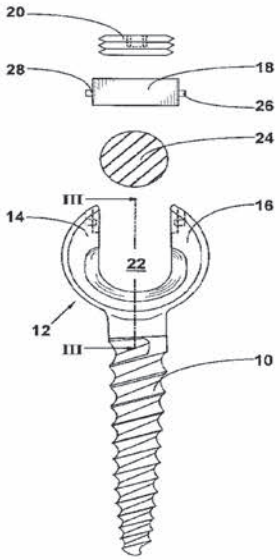
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(54) Verankerungselement zur Befestigung eines Stabes einer Vorrichtung zum Einrichten einer menschlichen oder tierischen Wirbelsäule an einem Wirbelknochen

(57) Verankerungselemente zur Befestigung eines Stabes einer Vorrichtung zum Einrichten einer menschlichen oder tierischen Wirbelsäule an einem Wirbelknochen, mit einer im wesentlichen U-förmig ausgebildeten und zwei im wesentlichen parallel angeordnete Haltestege (14, 16, 44, 46) umfassenden Halterung (12, 42), in dem ein Aufnahmeschlitz (22, 54) zur Aufnahme des Stabes (24) ausgebildet ist, und mit einem gegen den im Aufnahmeschlitz (22, 54) aufgenommenen Stab (22) wirkenden Sicherungselement, dadurch gekennzeichnet, dass das Sicherungselement ein Feststellelement (20, 50) und ein Ringelement (18, 48) umfasst, wobei das Ringelement (18, 48) mittels einer Renkverbindung am freien Ende der Haltestege (14, 16, 44, 46) anbringbar ist.



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VERANKERUNGSELEMENT ZUR BEFESTIGUNG EINES STABES EINER VORRICHTUNG ZUM EINRICHTEN EINER MENSCHLICHEN ODER TIERISCHEN WIRBELSÄULE AN EINEM WIRBELKNOCHEN

Die vorliegende Erfindung betrifft ein Verankerungselement zur Befestigung eines Stabes einer Vorrichtung zum Einrichten einer menschlichen oder tierischen Wirbelsäule an einem Wirbelknochen, mit einern im wesentlichen U-förmig ausgebildeten und zwei im wesentlichen parallel angeordnete Haltestege umfassenden Halterung, in dem ein Aufnahmeschlitz zur Aufnahme des Stabes ausgebildet ist, und mit einem gegen den im Aufnahmeschlitz aufgenommenen Stab wirkenden Sicherungselement.

DE 202 07 850 U1

Aus dem DE 94 02 839 ist eine Pedikelschraube bekannt, die mit ihrem Gewindeschaft in einem Wirbelkörper verankerbar ist und die an ihrem aus dem Wirbelknochen herausragenden Ende eine U-förmig gebildete Halterung mit zwei parallel ausgerichteten Haltestegen aufweist. Dabei ist zwischen den Haltestegen ein Aufnahmeschlitz zur Aufnahme eines Distraktions- oder Kompressionsstabes ausgebildet, der mittels einem an den freien Enden der Haltestege befestigbaren Sicherungselement gesichert und fixiert werden kann. Dieses Sicherungselement setzt sich in einer ersten Ausführungsform aus einem sechseckigen, ringförmigen Element mit einer darin eingelassenen Feststellschraube zusammen, wobei das gesamte Sicherungselement in eine entsprechende Nut in den Haltestegen einschiebbar ist. Das Sicherungselement überspannt den Aufnahmeschlitz, so dass die Feststellschraube direkt auf den Stab wirkt, um diesen zu fixieren.

In einer anderen Ausführungsform setzt sich das Sicherungselement aus einem das Halteelement umschließenden Hülle mit Innengewinde zusammen, wobei die Hülle auf ein entsprechendes, auf den Außenseiten der Haltestege vorgesehenes Gewinde aufschraubbar ist, so dass die auf der Stirnseite der Hülle vorgesehene Feststellschraube in den Aufnahmeschlitz eingreifen kann, um den Stab zu fixieren.

Bei einer derartigen Vorrichtung muss also zunächst einmal die Pedikelschraube im Wirbelkörper verankert werden, um anschließend den Stab in den Aufnahmeschlitz einzulegen. Danach wird das Sicherungselement entweder in die Nuten eingeführt oder aber auf die Halterung aufgeschraubt, bevor der Wirbel bzw. der Stab durch Anziehen der Feststellschraube in die gewünschte Position gebracht wird. Dies hat sich in der Praxis als sehr schwierig herausgestellt, da entweder das Einführen des Sicherungselementes in die Nuten oder das Aufschrauben des Sicherungselementes auf die Halterung sehr viel Fingerspitzengefühl erfordert, wobei gleichzeitig darauf geachtet werden muss, dass der

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Wirbelkörper und/oder der Stab währenddessen nicht verrutscht.

Aus dem DE 297 10 484 ist ein Verankerungselement bekannt, bei dem an den Innenseiten der Haltestege ein Sägezahngewinde zur Aufnahme der Feststellschraube vorgesehen ist. Hierdurch wird erreicht, dass die bei einem normalen Gewinde radial auf die Haltestege wirkenden Kräfte entfallen und lediglich axial wirkende Kräfte am Haltesteg angreifen. Hierdurch wird ein Auseinanderbiegen der Haltestege verhindert, so dass auch das die Haltestege umfassende Ringelement entfallen kann. Auch hier hat es sich in der Praxis als sehr mühsam herausgestellt, die jeweilige Feststellschraube in das entsprechende Sägezahngewinde einzuschrauben und dabei gleichzeitig die Wirbelsäule und/oder den Stab so lange in der gewünschten Position zu halten, bis die Feststellschraube den Stab selbständig hält.

Davon ausgehend liegt der vorliegenden Erfindung die Aufgabe zugrunde, ein Verankerungselement zu schaffen, bei dem das Sicherungselement die auftretenden Kräfte zuverlässig aufnimmt und bei dem das Sicherungselement einfach und schnell anzubringen ist.

Als technische Lösung dieser Aufgabe wird erfindungsgemäß vorgeschlagen, das eingangs genannte Verankerungselement dadurch weiterzubilden, dass das Sicherungselement ein Feststellelement und ein Ringelement umfasst, wobei das Ringelement mittels einer Renkverbindung am freien Ende der Haltestege anbringbar ist.

Ein nach dieser technischen Lehre ausgebildetes Verankerungselement hat den Vorteil, dass das Ringelement lediglich axial auf die freien Ende der Haltestege aufgesetzt werden braucht und durch ein leichtes Verschwenken in seine endgültige, gesicherte Position gebracht werden kann. Ein derart gesichertes Ringelement hält den im Aufnahmeschlitz

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befindlichen Stab bereits provisorisch in der gewünschten Position, so dass der operierende Arzt nun in Ruhe das Feststellelement einschrauben kann, um den Stab zu justieren und zu fixieren.

Dabei hat es sich als vorteilhaft erwiesen, die Renkverbindung als Bajonettverschluss, mit einem radial abstehenden Greifer und einer schlitz- oder nutartigen Aufnahme auszubilden, wobei der Greifer in die Aufnahme eingreift, um das Ringelement der Haltestege zu fixieren. Ein solcher Bajonettverschluss ist kostengünstig realisierbar und erlaubt eine schnelle und einfache Anbringung des Ringelementes an der Halterung des Verankerungselementes.

Die Ausgestaltung der Aufnahme mit einer axialen Einführung und einem radialen Halteelement hat den Vorteil, dass der Greifer in einfacher Weise in die Einführung gebracht werden kann und durch Verdrehen in das Halteelement gelangt, um dort zu verharren und einen formschlüssigen Bajonettverschluss zu bilden.

Es versteht sich, dass der Stab beispielsweise als Distraktions-, Kompressions- oder Verbindungsstab ausgebildet sein kann.

In einer bevorzugten Ausführungsform ist das Ringelement in den Aufnahmeschlitz einführbar und zwischen den Haltestegen anbringbar, wobei der Greifer außen am Ringelement angebracht ist, während die Aufnahme in den Haltestegen angeordnet ist. Dies hat den Vorteil, dass hiermit das Ringelement ebenfalls im Aufnahmeschlitz integriert ist, so dass das gesamte Verankerungselement sehr klein ausgeführt werden kann.

In einer anderen, bevorzugten Ausführungsform umgreift das Ringelement die Haltestege, wobei die Aufnahme im Ringelement angeordnet ist, während der Greifer an den Haltestegen angebracht ist. Dies hat den

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Vorteil, dass auch hierdurch die vom Feststellelement ausgehenden radialen Kräfte vom Ringelement aufgenommen werden, ohne dass dabei die Haltestege in unerwünschter Weise auseinandergedrückt werden.

In noch einer anderen, bevorzugten Ausführungsform ist die Einführung V-förmig ausgebildet. Dies hat den Vorteil, dass der in diese Einführung einzuführende Greifer lediglich grob auf die Einführung aufgesetzt werden braucht und anschließend durch die V-förmige Ausgestaltung dennoch korrekt bis zum quer ausgerichteten Halteelement geführt wird, um anschließend durch Verschwenken des Ringelementes in dieses eingeführt zu werden. Hierdurch wird das Aufsetzen des Ringelementes auf die Haltestege weiter vereinfacht.

In einer weiteren bevorzugten Ausführungsform ist das Halteelemet nach oben ansteigend ausgebildet, wodurch das Ringelement nicht nur eine drehende, sondern zusätzlich eine axiale Bewegung vollziehen muß, um gelöst zu werden. Durch solch ein Zusatzerfordenis beim Lösen des Ringelementes wird ein unbeabsichtigtes Lösen des Ringelementes erschwert. Anloges gilt für eine Verbreiterung des Endes des Halteelementes.

In wieder einer anderen, bevorzugten Ausführungsform ist der Greifer als Stift als Flanke ausgebildet. Die Flanke liegt vorteilhafterweise mit einer größeren Fläche an dem Halteelement an, so dass über die dem-entsprechend höhere Reibung ein unbeabsichtigte Lösen des Ringelementes erwschwert wird.

In noch einer anderen bevorzugten Ausführungsform reicht der Greifer durch die Aufnahme hindurch und aus dieser heraus und ist derart gekrümmt oder geneigt, vorzugsweise in Richtung der auf das Sicherungselement weilenden Kräfte, so dass den Haltesteg nach innen

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gedrückt wird. Hierdruch werden die Haltestege aufgrund der wirkenden Haltekräfte des Verankerungselementees nach innen gedrückt und es ist gewährleistet, dass das Ringelement zuverlässig in den Haltestegen gehalten wird. Ein Herausspringen des Sicherungselementes aufgrund sich aufbiegenden Haltestegen wird so verhindert.

In einer bevorzugten Weiterbildung ist im Ringelement ein Gewinde zur Aufnahme des Feststellelementes vorgesehen. Neben dem oben genannten Vorteil, dass hierdurch eine geringe Baugröße erreicht wird, hat dies weiterhin den Vorteil, dass die vom Feststellelement ausgehenden radialen Kräfte vollständig vom Ringelement aufgenommen werden, ohne dass hierbei Verformungen wie im Stand der Technik auftreten.

Weitere Vorteile des erfindungsgemäßen Verankerungselementes ergeben sich aus der beigefügten Zeichnung und den nachfolgend beschriebenen Ausführungsformen. Ebenso können die vorstehend genannten und die noch weiter ausgeführten Merkmale erfindungsgemäß jeweils einzeln oder in beliebigen Kombinationen miteinander verwendet werden. Die erwähnten Ausführungsformen sind nicht als abschließende Aufzählung zu verstehen, sondern haben vielmehr beispielhaften Charakter. Es zeigen:

Fig. 1 eine Explosionsdarstellung einer ersten Ausführngsform eines erfindungsgemäßen Verankerungselementes mit einem Stab;

Fig. 2 eine Draufsicht auf das Ringelement gemäß Fig. 1;

Fig. 3 eine teilweise geschnittene Seitenansicht des Verankerungselementes gemäß Fig. 1, geschnitten entlang Linie III - III in Fig. 1;

Fig. 4 eine Explosionsdarstellung einer zweiten Ausführungsform eines erfindungsgemäßen Verankerungselementes mit einem Stab;

Fig. 5 eine Draufsicht auf das Ringelement gemäß Fig. 4;

Fig. 6 eine Seitenansicht des Verankerungselementes gemäß Fig. 4;

Fig. 7 eine Explosionsdarstellung einer dritten Ausführungsform eines

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erfindungsgemäßen Verankerungselementes mit einem Stab;

Fig. 8 eine Draufsicht auf das Ringelement gemäß Fig. 7;

Fig. 9 eine teilweise geschnittene Seitenansicht des Verankerungselementes gemäß Fig. 7, geschnitten entlang Linie IX - IX in Fig. 7;

Fig. 10 eine Explosionsdarstellung einer vierten Ausführungsform eines erfindungsgemäßen Verankerungselementes mit einem Stab;

Fig. 11 eine Draufsicht auf das Ringelement gemäß Fig. 10;

Fig. 12 eine Seitenansicht des Verankerungselementes gemäß Fig. 10;

Fig. 13 eine Explosionsdarstellung einer fünften Ausführungsform eines erfindungsgemäßen Verankerungselementes mit einem Stab;

Fig. 14 eine Draufsicht auf das Ringelement gemäß Fig. 13;

Fig. 15 eine Seitenansicht des Verankerungselementes gemäß Fig. 13;

Fig. 16 eine Explosionsdarstellung einer sechsten Ausführungsform eines erfindungsgemäßen Verankerungselementes mit einem Stab;

Fig. 17 eine Draufsicht auf das Ringelement gemäß Fig. 16;

Fig. 18 eine teilweise geschnittene Seitenansicht des Verankerungselementes gemäß Fig. 16, geschnitten entlang Linie XVIII - XVIII in Fig. 16;

Fig. 19 einer Explosionsdarstellung einer siebten Ausführungsform eines erfindungsgemäßen Verankerungselementes;

Fig. 20 eine Draufsicht auf das Ringelement gemäß Fig. 19;

Fig. 21 eine Seitenansicht des Verankerungselementes gemäß Flg. 19.

In den Figuren 1 bis 3 ist eine erste Ausführungsform eines als Pedikelschraube ausgebildeten Verankerungselementes dargestellt, wobei das Verankerungselement zur Einbringung in den Wirbelknochen einen Gewindeschaft 10, sowie eine U-förmig ausgebildete Halterung 12 mit zwei im Wesentlichen parallel angeordneten Haltestegen 14, 16, ein Ringelement 18 und ein als Madenschraube ausgeführtes Feststellelement 20 umfasst. Dabei ist in der Halterung 12 ein Aufnahmeschlitz 22 zur Aufnahme eines Stabes 24 vorgesehen, welcher über das sich aus dem Feststellelement 20

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und dem Ringelement 18 zusammensetzenden Sicherungselement fixiert wird.

In dieser Ausführungform sind am Ringelement 18 an sich gegenüberliegenden Seiten zwei Bajonett-Stifte 26, 28 radial abstehend ausgebildet, welche in eine entssprechende, an der Innenseite der Haltestege 14, 16 ausgebildete Einführung 30 und ein Halteelement 32 einsetzbar sind. Dabei wird das Ringelement 18 mit seinen beiden Stiften 26, 28 von oben in die nach oben offene Einführung 30 eingeführt, und bis an den Grund der Einführung 30 gebracht, bevor das Ringelement 18 um einige Winkelgrade verschwenkt wird, so dass die Stifte 26, 28 bis ans Ende des Halteelementes 32 geführt werden. In dieser Position angekommen, wird das Ringelement 18 losgelassen und verbleibt zuverlässig in dieser Position.

Wie aus Figur 3 gut ersichtlich ist, ist die Einführung 30 V-förmig ausgebildet, um einen großen Fangbereich zum Einführen der Stifte 26, 28 zu bilden.

Im Ringelement 18 ist ein Innengewinde 34 zur Aufnahme des als Madenschraube ausgebildeten Feststellelementes 20 vorgesehen. Dabei wird das Feststellelement 20 so weit in das Ringelement 18 hereingeschraubt, dass das Feststellelement 20 auf den Stab 24 drückt und diesen in der gewünschten Position fixiert.

In den Fig. 4 bis 6 ist eine zweite Ausführungsform eines erfindungsgemäßen, ebenfalls als Pedikelschraube ausgeführten Verankerungselementes dargestellt. Auch hier setzt sich das Verankerungselement aus einem Gewindeschaft 40 zur Anbringung des Verankerungselementes im Wirbelknochen, einer U-förmig ausgebildeten Halterung 42 mit zwei im Wesentlichen parallel angeordneten Haltestegen 44, 46, einem Ringelement 48 und einem als Madeschraube ausgeführten Feststellelement 50

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zusammen. In dieser Ausführungsform ist an den jeweiligen Innenseiten der Haltestege 44, 46 ein Innengewinde 52 zur Aufnahme des als Madenschrauben ausgebildeten Feststellelementes 50 ausgebildet. Damit in dieser Ausführungsform die auf die Haltestege 44, 46 wirkenden, radialen Kräfte nicht zu einem Aufbiegen der Haltestege 44, 46 führen, wird hierbei das Ringelement 48 außen um die Haltestege 44, 46 herumgelegt.

Auch in dieser Ausführungsform ist in der Halterung 42 ein Aufnahmeschlitz 54 eines Stabes 24 ausgebildet, welcher durch das Feststellelement 50 in der gewünschten Position festgestellt wird.

An den nach außen weisenden Seiten der Haltestege 44, 46 ist jeweils ein radial abstehender Stift 56, 58 vorgesehen, die in entsprechende, innenseitig am Ringelement 48 vorgesehene Einführungen 61 einführbar sind, wobei sich auch hier an die Einführung 60, 61 quasi rechtwinklig entsprechende Halteelemente 62, 63 anschließen. Auch hier sind die Einführungen 60, 61 V-förmig ausgeführt, um einen großen Fangbereich zu realisieren.

In den Fig. 7 bis 9 ist eine dritte Ausführungsform eines erfindungsgemäßen, ebenfalls als Pedikelschraube ausgeführten Verankerungselementes dargestellt. Diese dritte Ausführungsform unterscheidet sich von der ersten Ausführungsform gemäß Fig. 1 bis 3 dadurch, dass an der Innenseite der Haltestege 14, 16, sich an die Einführung 30 anschließend eine leicht nach oben ansteigendes Halteelement 66 ausgebildet ist, an dessen Ende eine Verbreiterung 68 vorgesehen ist. Dabei ist die Verbreiterung 68 im Wesentlichen kreisförmig gestaltet. In dieser Halteelement 66 ist der Stift 26, 28 einführbar und verklemmt sich bei entsprechendem Verdrehen des Ringelementes 18 in dem nach oben laufenden Halteelement 66, so dass hierdurch eine Klemmsicherung erreicht wird. Dabei steigt das Halteelement 66 in Richtung der auf das Sicherungselement wirkenden Kräfte.

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Die Verbreiterung 68 am Ende des Halteelementes 66 bewirkt auch, dass die beim Verdrehen des Ringelementes 18 zwischen Stift 26, 28, bzw. Ringelement 18 einerseits und den Haltestegen 14, 16 andererseits aufgebaute Spannung zumindest teilweise wieder abgebaut wird, da die Verbreiterung 68 teilweise in Richtung der Haltekraft erstreckt und somit den Druck zwischen Sicherungselement und Stab 24 zumimdest teilweise aufhebt. Gleichzeitig wird hierdurch eine zuverlässige und dauerhafte Sicherung des Ringelementes 18 erreicht, da zum Lösen des Ringelementes 18 eben dieser Druck wieder aufgebaut werden muß, was ohne externe, gezielte Krafteinwirkung nicht möglich ist. Dies bedeutet, dass sich das Ringelement 18 nicht von alleine lösen kann.

In den Fig. 10 bis 12 ist eine vierte Ausführungsform eines erfindungsgemäßen, ebenfalls als Pedikelschraube ausgeführten Verankerungselementes dargestellt. Diese vierte Ausführungsform unterscheidet sich von der zweiten Ausführungsform gemäß Fig. 4 bis 6 dadurch, dass an der Innenseite des Ringelementes 48, sich an die Einführung 61 anschließend eine leicht nach oben ansteigendes Halteelement 70 ausgebildet ist. In dieses Halteelement 70 ist der Stift 56, 58 einführbar und verklemmt sich bei entsprechendem Verdrehen des Ringelementes 48 in dem nach oben laufenden Halteelement 70, so dass hierdurch eine Klemmsicherung erreicht wird.

In einer hier nicht dargestellten Ausführungsform ist das Ende des Halteelementes 70, analog zum Halteelement 66 gemäß Fig. 9, verbreitert ausgebildet.

In den Fig. 13 bis 15 ist eine fünfte Ausführungsform eines erfindungsgemäßen, ebenfalls als Pedikelschraube ausgeführten Verankerungselementes dargestellt. Diese fünfte Ausführungsform unterscheidet sich von der zweiten Ausführungsform gemäß Fig. 4 bis 6 dadurch, dass hier der Greifer

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als Bajonett-Flanke 72, 74 ausgebildet ist, die in eine entsprechende Einführung 76, 77 und Halteelement 78 am Ringelement 48 einführbar ist. Durch die breite Flanke 72, 74 entsteht eine große Anlagefläche zwischen Ringelement 48 und Haltesteg 44, 46, was zu einer großen Reibung führt, sobald das Ringelement 48 vorschriftsmäßig aufgesetzt ist. Diese Reibung widerum erschwert das unbeabsichtigte Lösen des Ringelementes 48, so dass hierdurch eine Sicherung gegen unbeabsichtigtes Lösen des Ringelementes 48 erreicht wird.

In den Fig. 16 bis 18 ist eine sechste Ausführungsform eines erfindungsgemäßen, ebenfalls als Pedikelschraube ausgeführten Verankerungselementes dargestellt. Diese sechste Ausführungsform unterscheidet sich von der ersten Ausführungsform gemäß Fig. 1 bis 3 dadurch, dass auch hier die Stifte durch Flanken 80, 82 ersetzt wurden, die in eine entsprechende Einführung 84 und Halteelement 86 eingreifen. Im übrigen gilt das zur fünften Ausführungsform gesagte analog.

Die in den Fig. 19 bis 21 dargestellte siebte Ausführungsform eines erfindungsgemäßen Verankerungselementes entspricht im wesentlichen der in den Fig. 1 bis 3 gezeigten ersten Ausführungsform, einzig der Greifer des Bajonettverschlusses ist hier anders ausgebildet. Wie Fig. 19 zu entnehmen ist, ist der Greifer des Bajonettverschlusses als ein radial abstehender, nach oben geneigter Stift 90, 92 ausgebildet. Dieser Stift 90, 92 ist länger als der vergleichbare Stift 26, 28 in Fig. 1.

Nachdem der Stab 24 in den Aufnahmeschlitz 22 eingelegt wurde, wird das Ringelement 18 ebenfalls in axialer Richtung in den Aufnahmeschlitz 22 eingeführt. Dabei sind die Stifte 90, 92 so ausgerichtet, dass sie in die Einführung 30 gelangen. Nun muss der operierende Chirurg das Ringelement 18 mit angemessener Kraft auf den Stab 24 aufdrücken, so das letzterer tiefer in den Aufnahmeschlitz 22 hineingedrückt wird, und so

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dass die Stifte 90, 92 bis auf den Grund der Einführung 30 gelangen. In dieser Position angekommen, kann das Ringelement 18 um eine Winkelbreite verschwenkt werden, so dass die Stifte 90, 92 in das Halteelement 32 gelangen. Da der Stab 24 hierbei vorgespannt wird, drückt letzterer dauerhaft auf das Ringelement 18. Das heißt gemäß den Fig. 19 bis 21 wird das Ringelement 18 nach oben gedrückt. Die Stifte 90, 92 sind nun so lang ausgeführt, dass diese aus dem Halteelement 32 herausragen und entsprechend der auf das Ringelement 18 wirkenden Kraft ebenfalls nach oben geneigt sind. Durch diese Neigung der Stifte 90, 92 werden die durch den Stab 24 auf die Stifte 90, 92 wirkenden Kräfte in einer Axial- und einer Radialkomponente zerlegt. Dabei bewirkt die Radialkomponente, dass die Haltestege 14, 16 nach innen gedrückt werden. Hierdurch wird gewährleistet, dass das Ringelement 18 auch bei großen, auftretenden Kräften zuverlässig in den Haltestegen 14, 16 fixiert wird.

In einer anderen, hier nicht dargestellten Ausführungsform sind die Stifte gekrümmt ausgebildet, ebenfalls um die Haltestege nach innen zu drücken.

Es versteht sich, dass die Flanke 80, 82 gemäß Fig. 60 bis 80 ebenfalls geneigt oder gekrümmt ausgebildet sein kann.

Der Stab 24 kann je nach Verwendungszweck beispielsweise als Verbindungs-, Distraktions- oder Kompressionsstab ausgebildet sein.

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Bezugszeichenliste:

10	Gewindeschaft	61	Einführung
12	Halterung	62	Halteelement
14	Haltesteg	63	Halteelement
16	Haltesteg	66	Halteelement
18	Ringelement	68	Verbreiterung
20	Feststellelement	70	Halteelement
22	Aufnahmeschlitz	72	Flanke
24	Stab	74	Flanke
26	Stift	76	Einführung
28	Stift	77	Einführung
30	Einführung	78	Haltelement
32	Halteelement	80	Flanke
34	Innengewinde	82	Flanke
40	Gewindeschaft	84	Einführung
42	Halterung	86	Halteelement
44	Haltesteg	90	Stift
46	Haltesteg	92	Stift
48	Ringeelement		
50	Feststellelement		
52	Innengewinde		
54	Aufnahmeschlitz		
56	Stift		
58	Stift		

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Ansprüche:

1. Verankerungselemente zur Befestigung eines Stabes einer Vorrichtung zum Einrichten einer menschlichen oder tierischen Wirbelsäule an einem Wirbelknochen, mit einer im wesentlichen U-förmig ausgebildeten und zwei im wesentlichen parallel angeordnete Haltestege (14, 16, 44, 46) umfassenden Halterung (12, 42), in dem ein Aufnahmeschlitz (22, 54) zur Aufnahme des Stabes (24) ausgebildet ist, und mit einem gegen den im Aufnahmeschlitz (22, 54) aufgenommenen Stab (22) wirkenden Sicherungselement, dadurch gekennzeichnet, dass das Sicherungselement ein Feststellelement (20, 50) und ein Ringelement (18, 48) umfasst, wobei das Ringelement (18, 48) mittels einer Renkverbindung am freien Ende der Haltestege (14, 16, 44, 46) anbringbar ist.

2. Verankerungselement nach Anspruch 1, dadurch gekennzeichnet, dass die Renkverbindung als Bajonettverschluß ausgebildet ist, wobei der Bajonettverschluß eine schlitz- oder nutartige Aufnahme und einen in die Aufnahme eingreifenden Greifer umfasst.

3. Verankerungselement nach Anspruch 2, dadurch gekennzeichnet, dass die Aufnahme eine axiale Einführung (30, 61, 76, 77, 84) und ein tangentiales Halteelement (32, 62,63, 66, 70, 78, 86) umfasst.

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4. Verankerungselement nach wenigstens einem der Ansprüche 2 oder 3, dadurch gekennzeichnet, dass das Ringelement (18) axial in den Aufnahmeschlitz (22) einführbar und zwischen den Haltestegen (14, 16) anbringbar ist, wobei der Bajonettgreifer aussen am Ringelement (18) angebracht ist, während die Aufnahme in den Haltestegen (14, 16) angeordnet ist.

5. Verankerungselement nach wenigstens einem der Ansprüche 2 oder 3, dadurch gekennzeichnet, dass das Ringelement (48) die Haltestege (44, 46) umgreift, wobei die Aufnahme im Ringelement (48) angeordnet ist, während der Greifer an den Haltestegen (44, 46) angebracht ist.

6. Verankerungselement nach wenigstens einem der Ansprüche 3 bis 5, dadurch gekennzeichnet, dass die Einführung (30, 61, 76, 77, 84) V-förmig ausgebildet ist.

7. Verankerungselement nach wenigstens einem der Ansprüche 3 bis 6, dadurch gekennzeichnet, dass das Halteelement (66, 70) leicht nach oben steigend ausgebildet ist.

8. Verankerungselement nach wenigstens einem der Ansprüche 3 bis 7, dadurch gekennzeichnet, dass sich das Halteelement (66) am Ende verbreitert.

9. Verankerungselement nach wenigstens einem der Ansprüche 2 bis 8, dadurch gekennzeichnet, dass der Greifer als Stift (26, 28, 56, 58, 90, 92) oder Flanke (72, 74, 80, 82) ausgebildet ist.

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10. Verankerungselement nach wenigstens einem der Ansprüche 2 bis 9, dadurch gekennzeichnet, dass der im wesentlichen radial abstehende Greifer durch die Aufnahme hindurch und aus dieser heraus reicht, wobei der Greifer derart gekrümmt oder geneigt ist, dass der im Bereich des Halteelementes (32) am Haltesteg (14, 16) zur Anlage kommende Greifer diesen nach Innen drückt.

11. Verankerungselement nach Anspruch 10, dadurch gekennzeichnet, dass der Greifer in Richtung der auf das Sicherungselement wirkenden Kräfte gekrümmt oder geneigt ist.

12. Verankerungselement nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, dass im Ringelement (18, 48) ein Gewinde (34, 52) zur Aufnahme des Feststellelementes (20, 50) vorgesehen ist.

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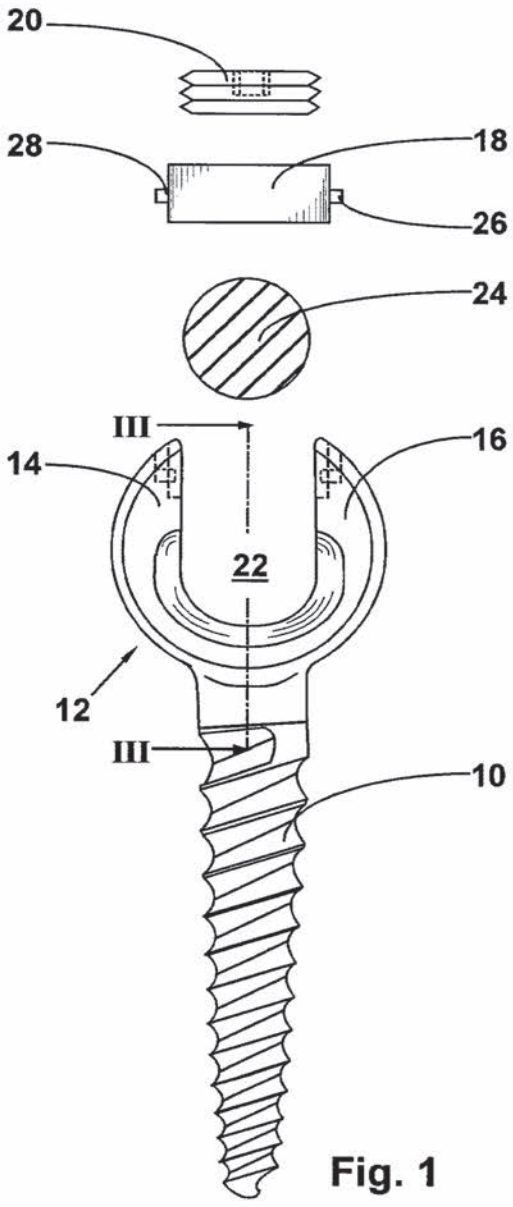


Fig. 1

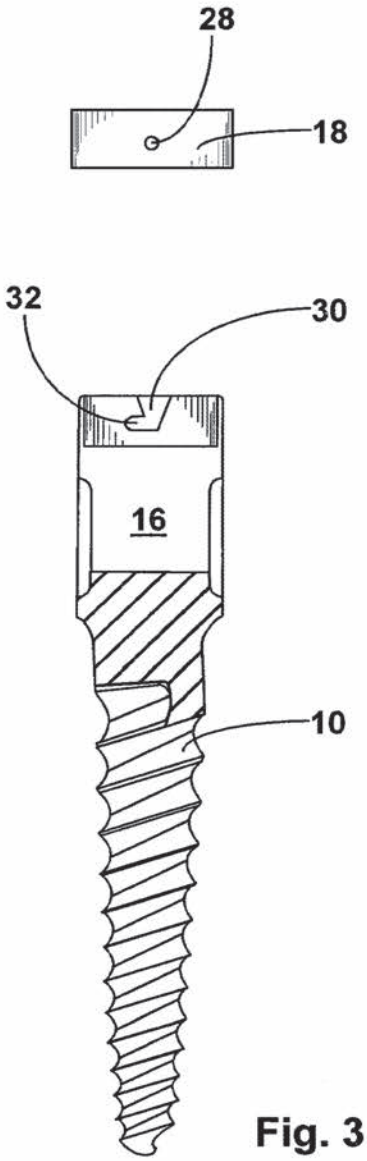


Fig. 3

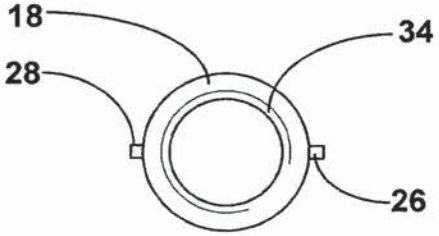


Fig. 2

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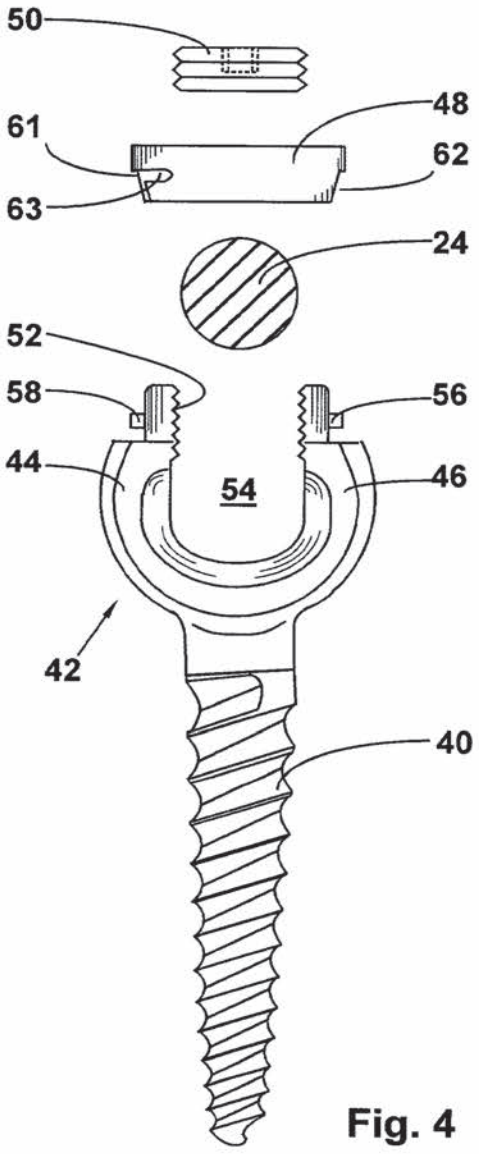


Fig. 4

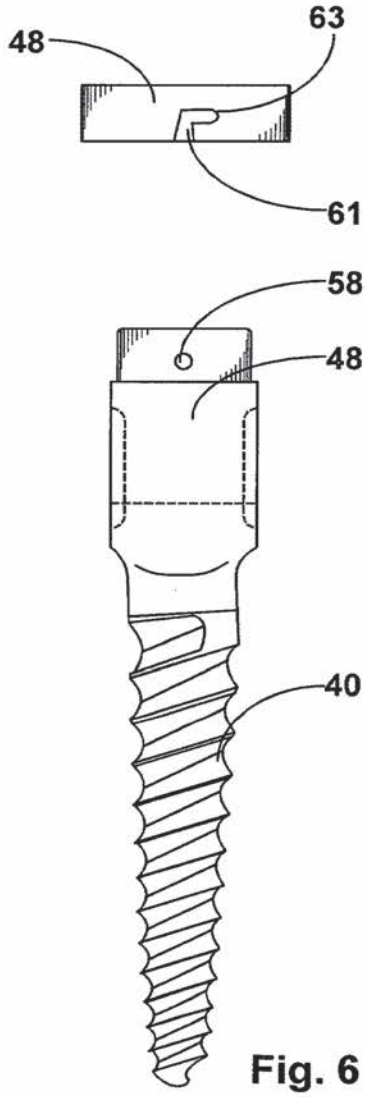


Fig. 6

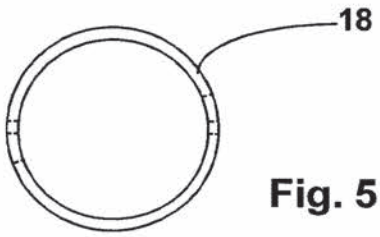


Fig. 5

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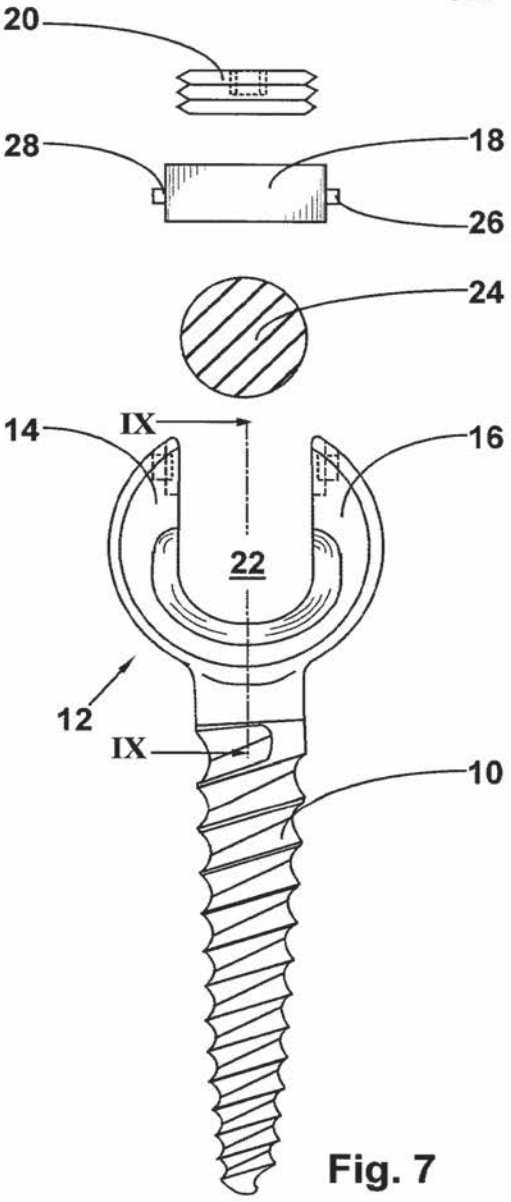


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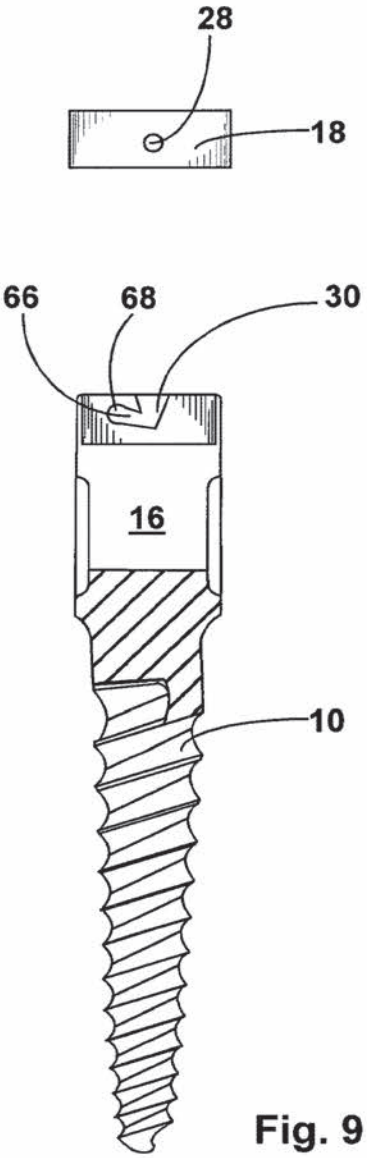


Fig. 9

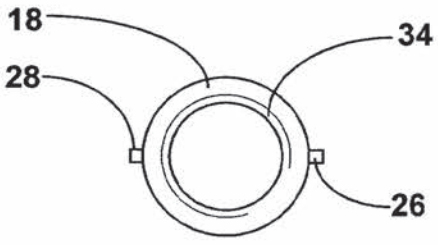


Fig. 8

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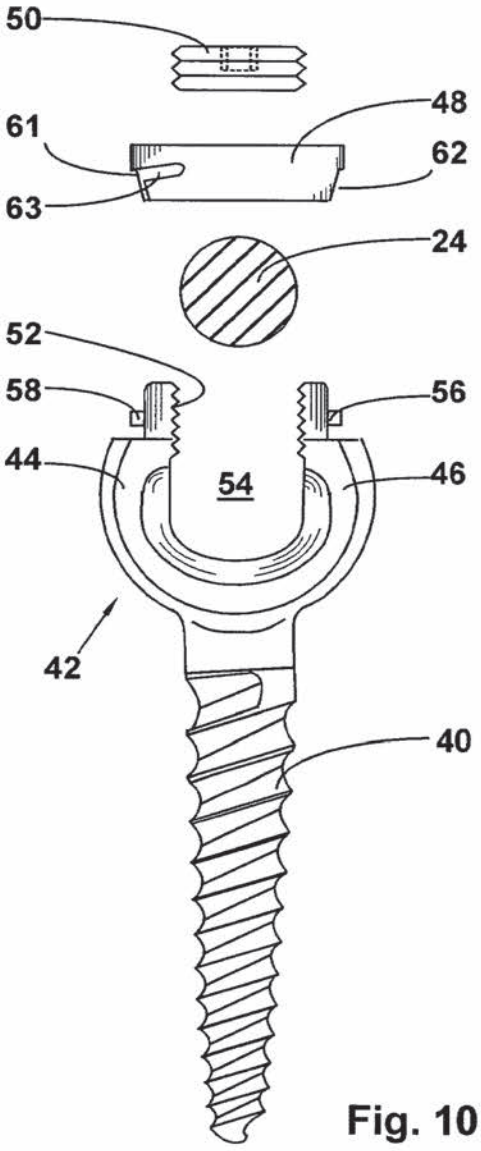


Fig. 10

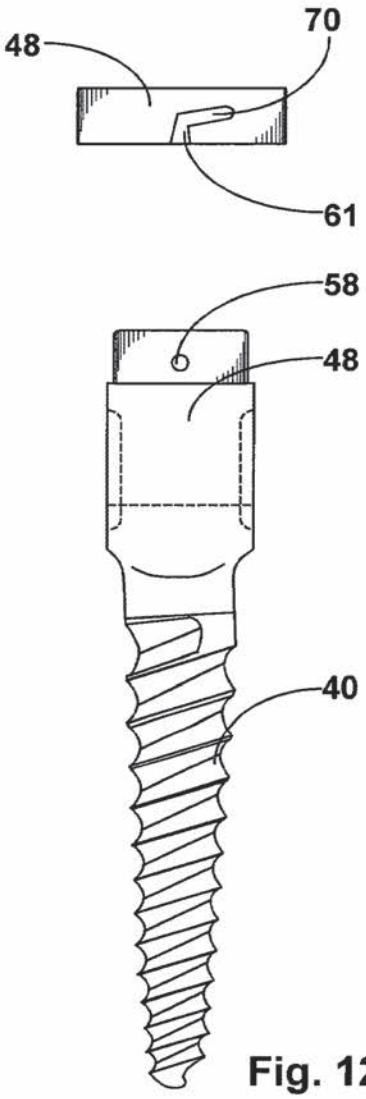


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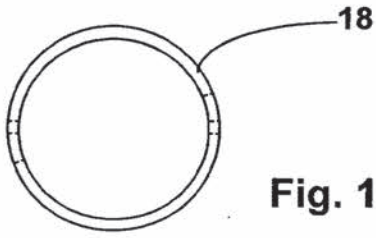


Fig. 11

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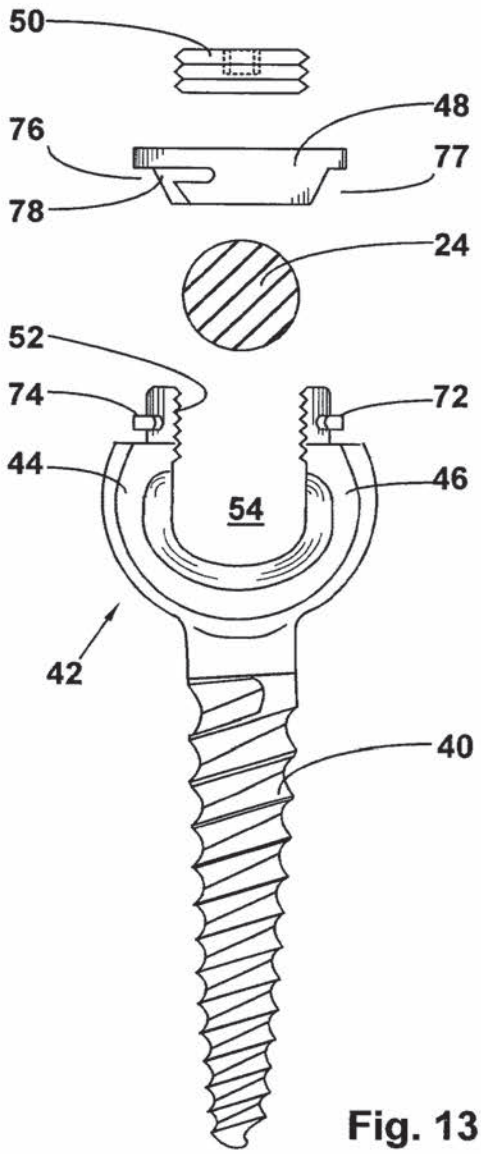


Fig. 13

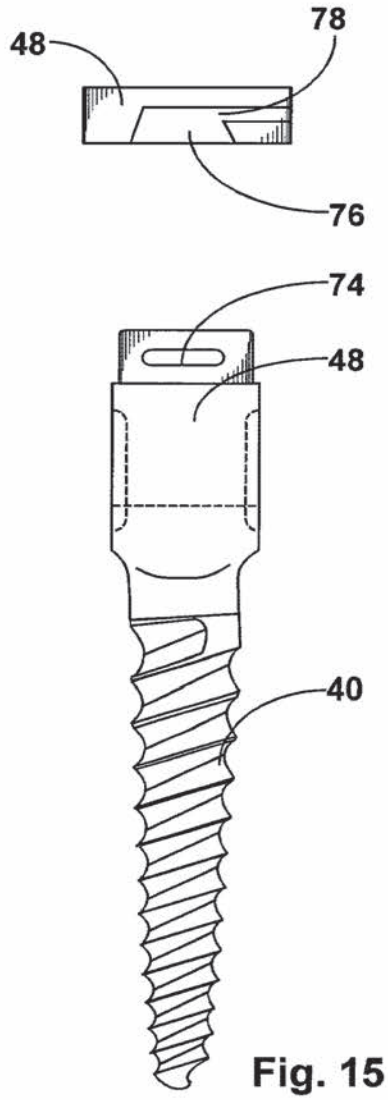


Fig. 15

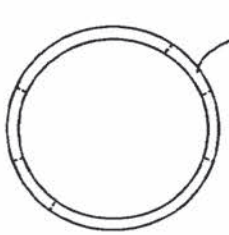


Fig. 14

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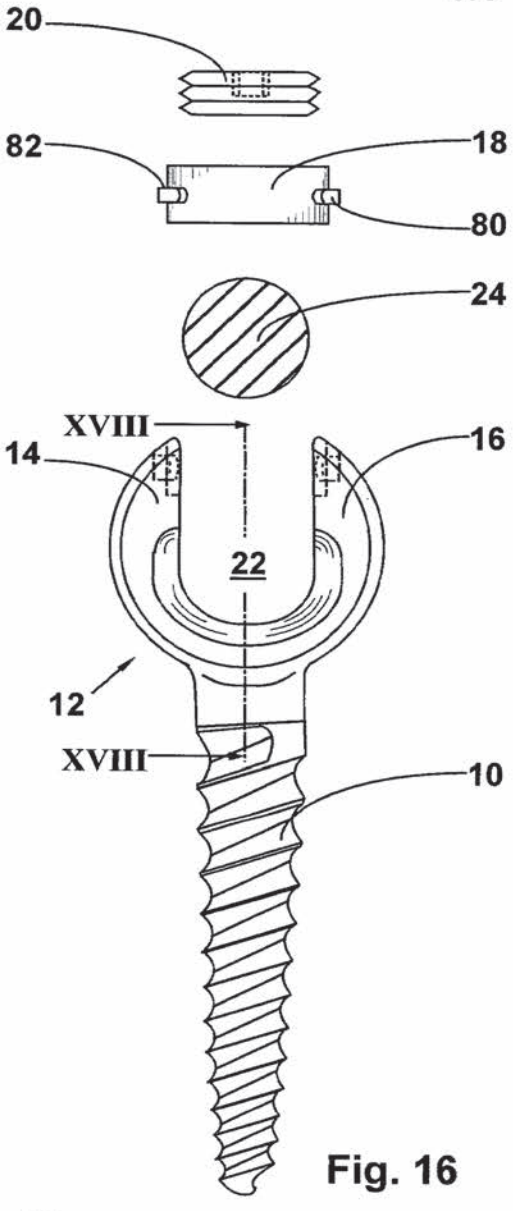


Fig. 16

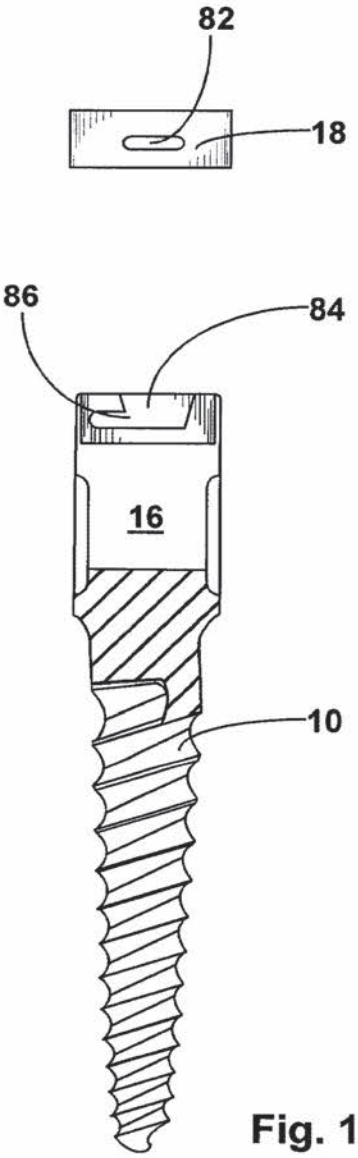


Fig. 18

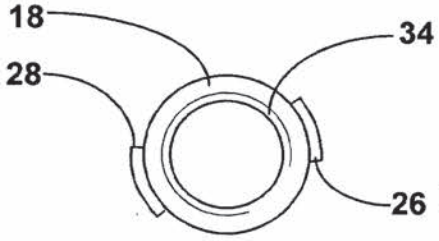


Fig. 17

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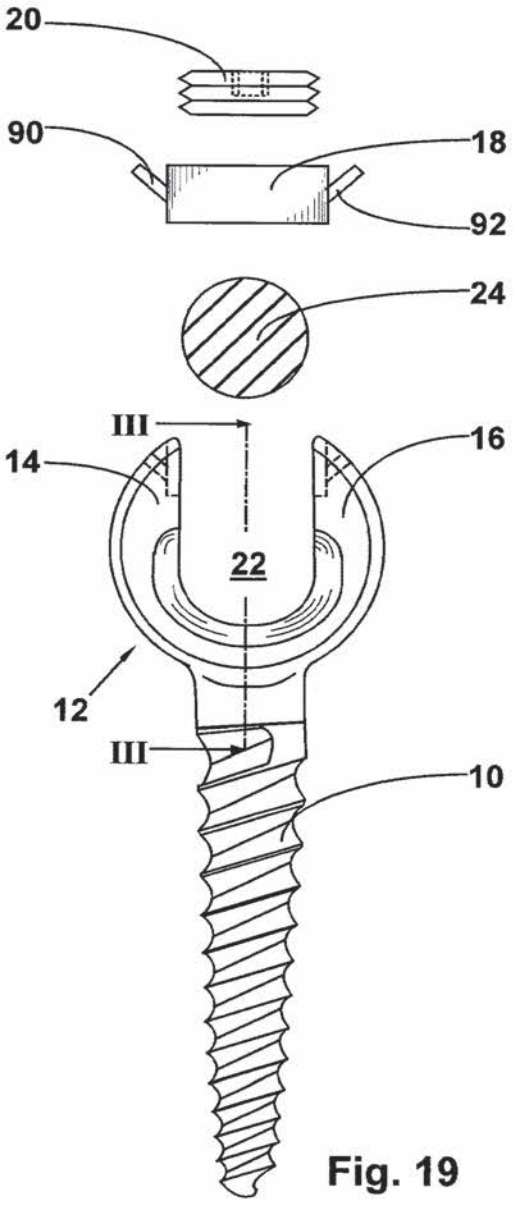


Fig. 19

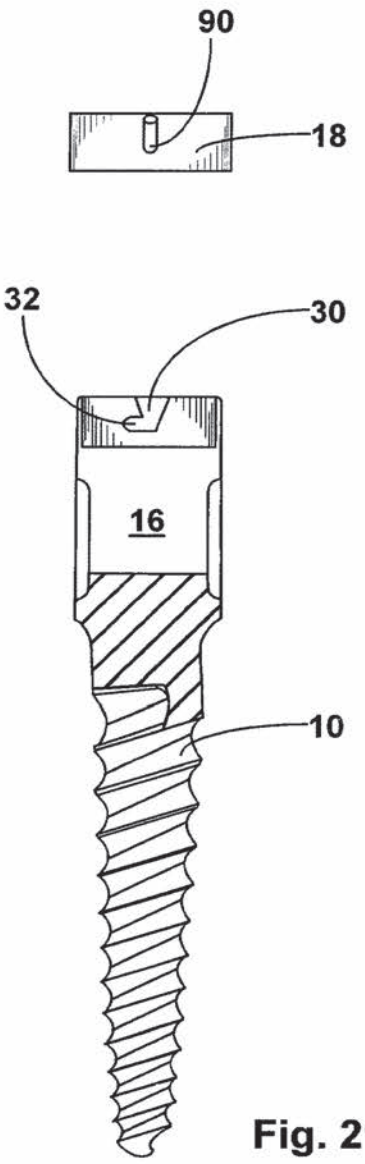


Fig. 21

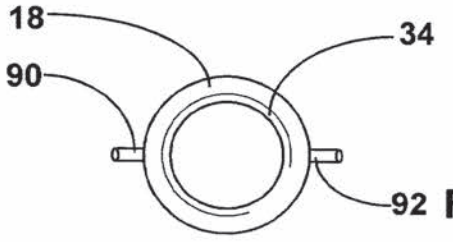


Fig. 20

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